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Market Capitalization and Firm Value: The Size Factor

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This is to certify that the doctoral dissertation by

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Abstract

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MBA, Laurentian University, 2009

BAS, York University, 1997

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Abstract

Current multifactor valuation pricing models use size (measured by market capitalization) of a firm as one factor to determine the value of a security. The problem with current standard models was that none of them could explain the value of a security consistently and accurately based on current factors and in particular the size factor. The purpose of this quantitative study using existing time-series data over a 10-year period from 2006 to 2015 was to examine the impact of size factor on the realized rate of return of financial securities, while controlling for the impact of market rate of return. There are currently many valuation models but there is no 2-factor model or a model that uses a size factor that includes mid-cap sized securities. The research questions examined mid-cap sized securities for the size factor in a 2-factor model to determine the accuracy of predicting financial returns compared to the current standard Fama-French 3-factor model. The main theoretical framework that guided the study was the efficient market hypothesis that postulates that the price of a stock reflects all relevant available information. Data were collected for historical returns of 15 individual firms and portfolios of securities based on size. Multiple regression analysis methodology was used to examine the impact of size factor on the realized rate of return of financial securities, while controlling for the impact of market rate of return in the modified 2-factor model that included mid-caps. The results of the study indicate that size is a statistically significant factor in a 2-factor model that included mid-caps. The positive social impact of this study is that it could provide greater confidence in financial markets by providing a fair and equitable means of investment and flow of capital for a robust economy.

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Chapter 1: Introduction to the Study

Snieska, Venckuviene, and Masteikiene (2016) postulated that liquidity and credit shocks were the impetus for the global financial crisis of 2008, and had severe consequences for U.S. financial markets and impacted the flow of capital into the areas of the U.S. economy that were needed for growth and prosperity. Financial markets were an essential medium for the flow of capital both locally and globally, and this was evident when central banks had taken monetary policies during the financial crisis to ensure global markets did not collapse (Park, Racouldand, & Shin, 2016). For market participants to make optimal financial decisions, they must agree on the price of the financial security and this requires determining the value of that security based on risk factors (Cal & Lambkin, 2017). Valuation based on risk factors becomes central in making transactions through the medium of financial markets, especially during economic uncertainty. There were many financial tools or models available to decision makers in determining the value of a security, and the most reliable and consistently studied in the academic literature and by practitioners were factor models since the introduction of the one factor model or capital asset pricing model (CAPM) by Sharpe (1964). Financial models that utilize factors or independent variables have evolved and have led to many multifactor models. A multifactor model was a model with more than one factor or independent variable. The focus of this study was the examination of the seminal Fama-French three factor model (Fama & French, 1993) and a three-factor model that uses three different factors to determine value not only in normal economic conditions but during extreme volatility.

The main factor in the Fama-French three factor model that was tested by Fama-French (1993) to determine the value of a financial security was the size factor or the market capitalization of a security or portfolio of securities. The size factor in most multifactor models was calculated based on the returns between portfolios of small and large sized firms where size was based on market capitalization. Market capitalization was the market price of a share or common stock multiplied by the number of shares outstanding (Berk & DeMarzo, 2014). The indices that were used for market capitalization were the Russell 2000 index for small caps, Russell midcap index, Russell 200 index for big caps, and the Russell 3000 index for the whole market and were ranked on the last day of trading in the month of Could (Chang, Hong, & Liskovich, 2015). The basis of using the size factor in the determination of value was based on past observed anomalies of the performance of small sized stocks (Balakrishnan, 2016) where they outperform big size firms and provide a better explanation of returns when used in multifactor models.

In this chapter, I examine the background of current valuation models and their application in the financial decision-making process. This will include the problem statement and current gap in the literature followed by the purpose of the study. Also provided in this chapter were the research questions and hypotheses with a detailed description of the variables that I studied, along with the theoretical foundations that formed the basis of this study. The end of the chapter will conclude with the assumptions, definitions, scope, and finally the significance of the study.

Background of the Study

The valuation of a financial security was the basis of completing the sale of a financial security between a buyer and seller. The respective parties must independently value the asset to negotiate the price for the exchange (Cal & Lambkin, 2017). The medium or space where financial transactions occur were financial markets or exchanges and were located throughout the globe. For financial markets to serve their economic purpose in society, they must be fair and equitable by being assessable and providing reliable financial information for all market participants to make rational financial decisions. If markets were efficient, then valuation models or tools should provide market participants the ability to fairly and accurately measure the value of financial securities. There were many valuation tools that had been developed and used by past researchers and investors such as the CAPM that determined a stock excess return that was not explained by market excess return (Alves, 2013). The original CAPM model was expanded by Eugene Fama and Kenneth French to include other factors like market capitalization and book-to-market factors to determine a security's value and was the Fama-French three factor model (Fama & French, 1993). The focus of the study was to examine and evaluate the Fama-French three factor model, and in particular, the accuracy and robustness of the model to determine a security value based on a specific factor--market capitalization--and to determine if using only two-factors were a viable model.

Problem Statement

The tools used to determine security prices were valuation models and was central in the financial decision-making process that allowed market participants to transact in a fair and equitable manner to optimize returns based on risk factors (Cal & Lambkin, 2017). However, during the financial crisis of 2008, the Dow Jones industrial average dropped 54% and created major losses to market participants (Zhou & Zhu, 2010) and brought into question the viability of current valuation models. The general problem under study was the inability of current valuation models like the Fama-French three factor model (FF model) to explain consistently and reliably a security's value based on performance (Davies, Fletcher, & Marshall, 2015). The specific problem under investigation was the effect of size in the FF model, as measured by market capitalization (cap) using small and large cap firms (Riro, & Wambugu, 2015). The current gap in the literature was the exclusion of midsize cap securities in determining stocks' returns and value and the absence of a stand-alone two-factor model (Cochrane, 2011). I studied the FF model using quantitative methods, and the population of securities under examination was listed on U.S. stock exchanges (NYSE, NASDAQ, and AMEX).

Purpose of the Study

The purpose of this quantitative study, where I used a quasi-experimental design in a time-series experiment, was to explore and understand the size factor in current valuation models and its effects on the value of a financial security. My goal was to provide the foundation for developing better valuation tools that will assist in the financial decision-making process of determining the price to make transactions and markets more efficient. The independent variables or factors in the FF model were market premium, market capitalization (size), and book-to-market ratio. The dependent variable was the returns or value of a security or portfolio of securities. In this study, I used quantitative methods based on a quasi-experimental design using a time-series experiment (Campbell & Stanley, 1963). The empirical nature of value required the collection of individual data or security prices on a recognized exchange, and for this study, I collected financial information on firms listed on the National Association of Securities Dealers Automated Quotations (NASDAQ). For other financial information regarding other variables in the valuation models, I utilized information from three exchanges NASDAQ, New York Stock Exchange (NYSE), and American Stock Exchange (AMEX). The purpose of this investigation was to assist market participants to value firms with better valuation models and understand how the size of the firm impacts value along with other factors. This was to provide greater confidence of financial markets and become more accessible and fair mechanism for the of flow capital in a robust economy that could benefit society as a whole and not just for those with the financial means and knowledge.

Research Questions and Hypotheses

I focused the first research question on the accuracy and reliability of the FF model's ability to predict future market values of individual stocks based on market size, which then can determine the effectiveness of the models as tools for making informed financial decisions. I based this on the assumption that market prices accurately reflect reasonably all available information that an investor would use in making investment decisions based on future expected returns. In the second question, I used portfolios instead of individual stocks to determine if size, as measured by market capitalization, affects the accuracy of financial returns using the FF model modified only using two-factors or market premium and the size factor. In the third research question, I examined the effect of the dependent variable of returns by repeating tests of the current models and analyzing each variable grouped in pairs in the model to assess the effectiveness of the measure and to ensure the internal reliability of the hypothesis of research questions one and two. The pair groupings that I utilized for the two-factors were market capitalization and book-to-market (B/M) and were respectively small, midsize, and big caps and low, medium, and high B/M. This was represented by nine groupings of market capitalization and B/M or small/low (SL), small/medium (SM), small/high (SH), midsize/low (MDL), midsize/medium (MDM), midsize/high (MDH), big/low (BL), big/medium (BM), and big/high (BH). I designed the groupings to include mid cap firms. In past studies, researchers used only six groupings based on small and big caps; in this study, I expanded the investigation by including midsize cap firms and was the focus of the last research question.

1. RQ 1: What are the differences, if any, between using different sized stocks (small, mid-cap, or big) in the accuracy of predicting financial returns informed by the FF model?

$H_0$1: Market capitalization as a proxy for size is not a significant predictor of future returns of a stock using the FF model.

H_a1: Market capitalization as a proxy for size is a significant predictor of future returns of a stock using the FF model.

The independent variable is the size factor, and the dependent variable is stock's return.

2. RQ 2**:** What are the differences, if any, between using different sized portfolios (small, mid-cap, and big) in the accuracy of predicting financial returns informed by the modified FF model with only two-factors that included mid-caps?

   $H_0$2: Market capitalization as a proxy for size is not a significant predictor of future returns of a portfolio using the modified FF model.

   H_a2: Market capitalization as a proxy for size is a significant predictor of future returns of a portfolio using the modified FF model.

   The independent variable is the size factor and the dependent variable is the portfolio's return.

3. RQ 3: What are the differences, if any, between using nine groupings of portfolios based on size and B/M in the accuracy of predicting financial returns informed by the modified FF model with only two-factors that included mid-caps?

   $H_0$3: Grouping based on both market cap and B/M is not a significant predictor of future returns of a portfolio using the modified FF model.

H_a3: Grouping based on both market cap and B/M is a significant predictor of future returns of a portfolio using the modified FF model.

The independent variables are the size and B/M, and the dependent variable is the portfolio's return.

The statistical analysis used to test the hypothesis was linear multiple regression analysis using *t*-tests, *F*-ratios, and adjusted R^2. The valuation model that was tested was the FF model and the descriptions of the terms in the model were in Table 1.

Fama-French Three Factor Model (Fama & French, 1993) – Regression equation 1

$$Rit = Rft + \beta i(Rmt - Rft) + siSMBt + hiHMLt + \varepsilon it \quad (1)$$

Table 1

Variable Descriptions - Fama-French Three Factor Model

Term	Description	
Rit	Rate of return on a security *i* during time *t*	Depedent variable
Rft	Risk free rate *f* during time *t*	Independent variable
βi	Beta measure of systematic risk of a security *i*	Coefficient
Rmt	Market return *m* during time *t*	Independent variable
(Rmt − Rft)	Market premium (Market return *m* minus Risk free rate *f* during time *t*)	Independent variable
SMB_t	Market Capitalization - Small minus Big during time *t*	Independent variable
si	Linear regression of the defined SMB factor *s* of security *i*	Coefficient
HML	Book-to-Market - High minus Low during time *t*	Independent variable
hi	Linear regression of the defined HML factor factor *h* of security *i*	Coefficient
εit	Error term of the security *i* during time *t*	

Theoretical Foundation

The overarching theoretical frameworks that guided this study were the EMH (Fama & French, 1970), random walk (Fama, 1965), Modigliani-Miller theorem

(Modigliani & Miller, 1958) and the size effect anomaly. This was to provide the foundation as to the importance of information and volatility of financial markets as to their proper functioning and the effects of anomalies to extreme movements of stock prices. Market volatility, like the recent financial crisis and asset bubbles, could skew or under/overstate findings or relationships of the variables and was accounted for in the research methodology (Mishra, 2013). The assertions of the Modigliani and Miller (1958) were important for this study since the theory postulates the debt to equity ratio does not have an effect on value and to be consistent with this theory it was tested using the book-to-market ratio and was examined to ensure that this does not affect the results of analysis of market capitalization. The original works and theories of Fama-French (1993) were the basis for creating, testing, and analyzing the FF model. To ensure reliability and validity of results, researchers in past studies tested and examined the FF model and I used as a guide and for comparison purposes like the study by Sehgal and Balakrishnan (2013). The time frame that I used for the data collection was the returns and stock prices that covered a 10-year period from 2006 to 2015, and I divided this period into two periods with the first between 2006 to 2010 when the market crash of 2008 occurred. The second period was during 2011 to 2015 to examine less extreme market conditions. The breakpoint I used for the two periods was determined based on the volatility index (VIX) and was a measure of the market's expectation of stock market volatility and has been referred to as the *fear index* (Jung, 2016). The average daily VIX for the period between 2006 and 2015 was 20.42, and the breakpoint between the two periods was based on the VIX index, where for the first period during the financial crisis of 2008, 2006 to 2010, it was 23.46 or greater than the average and the next period, 2011 to 2015 was less than the average or 17.41 (Volatility Index (VIX), 2017).

The theories that I examined in this study were based on current multifactor models with a focus on the market capitalization or size factor. Lambert and Hubner (2014) re-examined the factors or variables in the FF model (Fama & French, 1993) and in particular, they focused on the past anomaly of the size effect in the U.S. stock market. The size effect anomaly was where small market caps tended to outperform big market cap firms. The main finding of their study was that the size effect was underestimated in the FF model. They also noted the sorting procedure used in the study of conditional rankings rather than independent rankings provided a finer size classification and better weight balances on small/big portfolios that reduced specification errors. Mishra (2013) found in the Indian Stock Market that the size factor in the FF model produced significant results for the model in determining the price of large sized stocks. Also, Mishra (2013) noted that when there were two-factors that were used jointly, they produced better results than when they were used individually.

Nature of the Study

I used a quantitative design for this study because of the empirical nature of the variables used in the FF model. I tested individual stocks and portfolios of stocks using a quasi-experimental design based on time-series experiments and described by Campbell and Stanley (1963). The specific area that I examined was the market capitalization or size of financial securities. To ensure that other variables or factors within the model were not affecting the results, I also tested each variable individually to ensure internal reliability. The research methodologies that I used for data collection and analysis were based on an existing study by Sehgal and Balakrishnan (2013), but I examined portfolios of individual securities and indices based on market caps. The data I collected was based on secondary data from recent financial information to ensure the findings were relevant in today's markets. I also collected data and tested for the period during the financial crisis to examine how this model performs under extreme market conditions and to determine the extent of external threats to the validity of the findings.

The statistical testing that I used was regression analysis that would determine the fit of the data collected to the FF model. Regression analysis also provided results as to how significant the models tested predicted the values of the dependent variable (DV), the returns, and the effect, from one or more independent variables (IVs), the cause, which included beta, market cap, and the book-to-market ratio (Field, 2013). The regression analysis that was performed produced results or observations that predict an outcome variable or firm value from one predictor variable (simple regression), like market capitalization, or several predictor variables or the three factors in the model (multiple regression).

Definitions

Factor: A factor or multiple factors are used in valuation models to determine or explain the change in the price or returns of a security or a portfolio of securities. In multifactor models, computations and specifically regression analysis are performed to compare two or more factors to analyze relationships between variables and the security's resulting performance or described as *return relevant factors* as indicated by Hakim, Hamid, & Mydin Meera (2015).

Financial Crisis: Is used as a general term to describe economic distress or uncertainty following economic booms or asset price bubbles (Thakor, 2015) and also to describe the extreme market volatility like that occurred during 2007/2008.

Financial Markets: Is a marketplace or space where buyers and sellers transact and trade financial securities either in an over-the-counter (OTC) dealer market or on an organized exchange (Bolton, Santos, & Scheinkman, 2016). For publicly listed companies that trade on regulated and recognized markets is referred to as stock exchanges.

Financial Security: A financial security is an instrument and can describe an equity ownership in a firm, a creditor position like a bond, or other types of financial instruments like an option. For this study, it described an equity ownership or an asset-backed security or for a firm through either common or preferred stock that is traded on a recognized stock exchange. This did not include financial derivatives like options that were contracts where the value was not dependent on the ownership of an asset but the value of an underlying security (Bertrand & Prigent, 2016).

Size: The determination of size is based on the relative dimension or magnitude of an object or subject relative to another object or subject. In valuation models, size is based on magnitude or proportion of the market price of a firm's stock multiplied by the number shares outstanding or market capitalization to another firm's market capitalization. They were categorized in factor models as being small, mid-cap, or big.

Valuation: An estimation of something's worth and can be subjective when determining the value of intangibles. Determining the value of a financial security or portfolio of securities for this research could utilize an objective process of estimation of worth based on financial information on factors used in multifactor models.

Volatility: Can describe abnormal movements in the price or value of a security price, a portfolio of securities, or to the overall markets were financial securities trade. It is a measurement of risk or for asset-return volatility, this can be referred to as the financial-market risk (Mittnik, Robinzonov, & Spindler, 2015).

Assumptions

My main assumption in this study was the degree of efficiency of financial information based on the EMH. The forms of efficiency were weak, semi-strong, and strong and were the basis for robust and fair markets. Ideally, markets should exhibit a semi-strong to a strong form of efficiency to avoid major financial fluctuations like the financial crisis of 2008, distribute wealth equitably, and avoid firms from falsifying financial information (Gilson & Kraakman, 2014). A higher order of efficiency was where market participants must be able to fairly value securities that were traded to complete an orderly and fair transaction between parties. This required valuation models that were available to all parties and were rigorous and robust to reasonably and accurately measure the value of financial securities to avoid those with the means to manipulate and control financial markets. I assumed that markets exhibit semi-strong to strong forms of efficiency.

I assumed that people trading on financial exchanges made optimal and rational financial decisions. Behavioral finance was a new field of study in finance and where financial decisions were made using both by an individual's behavior and cognitive psychology along with rational economic and financial decision-making (Mendes-da-Silva, Da Costa Jr., Ayres Barros, Rocha Armada, & Norvilitis, 2015). At the other extreme, with the advent of new technologies, high-frequency trading (HFT) utilizes powerful computing technologies to make large financial transactions at high speeds (Brogaard, Hendershott, & Riordan, 2014). Investors and academics in the field of finance have raised questions as to the efficiency of financial markets when some market participants transact in an unethical and unfair manner or privilege (HFT technology) to the determent of others (Cooper, Davis, & Van Vliet, 2016). Human behaviors could explain why individuals could make irrational financial decisions, and new technologies could provide advantages to some market participants but were not conclusive evidence of weak form of efficiency (Fama & French, 1970). I assumed any decisions made by market participants were based on producing optimal returns that used semi-strong to strong information and was reflected in the price of the financial security.

Scope and Delimitations

To ensure consistency with past studies and the availability of financial information, the scope of this study was limited to the examination of financial securities and other financial information that trade on the established U.S. stock exchanges. The U.S. stock exchanges included National NASDAQ, NYSE, and AMEX. These U.S. based exchanges were secondary markets, and I used them because the availability of data from the Kenneth R. French website (French, 2016) and other publicly available sources (Russell indices) and also because they were the largest financial markets in the world that have a long history of being studied. The individual financial securities that I examined were common stocks and the defined population based in the U.S. and the common stocks of firms that were publicly listed.

Establish Validity

The two main threats to validity were internal or external based on inferences or causal relationships identified or measured. Internal validity threats could occur from the research process, treatments used in the study, and independent variables that were manipulated (Creswell, 2013). The validity of the research process was based on established assessments of valuation models and utilized past studies. The internal validity for the treatment was established with the use of an appropriate risk-free rate and the calculation of beta for the same period for the data collected (Alves, 2013). I performed manipulation of the independent variables and was based on past studies to limit the threat of internal validity of the findings.

The external threats to validity for this study were the systematic market anomalies like the crisis of 2008 or volatility that could not be firm or industry specific. There were also global factors like currency exchange risk and geopolitical events that could not be controlled but, I took them into consideration when the results were reviewed and compared them with other results to establish external validity. I assumed that efficiency of financial markets or EMH was not the strong form otherwise investors would not be able to obtain excess returns, and would provide no incentives for market participants to buy and sell securities through financial markets and from past studies a strong form of efficiency had not been evident based on the large volumes of trades in all the major markets (Berk & DeMarzo, 2014). The capital structure of a firm could also affect validity based on Modigliani-Miller theorem (Modigliani & Miller, 1958) which stated this should not be a factor and for this study, I based the sample selection that capital structure of a firm did affect value since an increase or large amount of debt could affect borrowing costs and affect the ability to raise capital and reduce the cost of equity or the market value of the stock. Another threat to validity was market volatility and has in the past been a concern like with the recent financial crisis and asset bubbles that can skew or under/overstate findings or relationships of the variables. I considered some volatility as a natural aspect of financial markets and was described in the current literature as the random behavior of stock price movements where stock prices should not be predictable and appear to move randomly (Mishra, 2013). Theoretically, this could be a threat since valuation models should not be effective in predicting future market prices based on historical information but was the same issue that all past studies of valuation models faced and needed to be acknowledged within the study.

Limitations and Delimitations

The potential design and methodological weaknesses of the research can be broken down by the firm, industry, and market risks. Firm-specific risks were those aspects faced by businesses that were unique to the firm or unsystematic risks. I purposefully chose fifteen firms for the sample data to provide more rigor to the statistical tests to show the weaknesses of the models tested. I also took into account the complications of the life cycle of a firm (Hanks, 2015) like growth and mature phases by choosing the firms by their market capitalization to resolve business cycle issues based on their size relative to other firms listed on public exchanges. Another limitation was the industry risks or other idiosyncratic risks, and I addressed this issue with the use of different time periods to establish validity. An unavoidable limitation I faced was the market risks and volatility based on systemic issues with the economy or global and geopolitical events and required a separate analysis to see how the models would fair under extreme conditions, but only the financial market crash of 2008 was accounted for in the tests. Since the data were readily available, tests of models used a sample set before, during, and after the financial crisis of 2008. These tests I performed required additional work but provided better guidance and explanation as to the effects of value under extreme market conditions and was done to determine the extent of the threat to validity in comparison to normal market conditions.

The three periods of data collection were a concern because of market anomalies or systemic factors that could affect the statistical tests that I performed. The period of data collection was a limitation based on the time-series regression analysis that was used since this required data over a period of time where there were anomalies and compared to different periods that could have unique systematic risk specific to the period of time tested. Systematic risk impacted the external validity since there were market anomalies like the financial crisis of 2008 during the period of examination that could have skewed the results of the regression analysis. I collected data for a ten-year period from 2006 to 2015 and to avoid market anomalies; I divided the testing into three periods. The main period for I analyzed was for the full 10-years and two 5-year periods from 2006 to 2010 and 2011 to 2015. This was to isolate the market crash of 2008 and could provide insights as to the effects of the crash to the results based on the volatility index or VIX. The breakpoint between the two periods was based on the average daily volatility index or VIX. The VIX between 2006 and 2015 was 20.42 and the breakpoint for this first period or when the financial crisis of 2008 occurred, 2006 to 2010, it was 23.46 or greater than the average and the next period, 2011 to 2015 was less than the average or 17.41 (Volatility Index (VIX), 2017).

The main delimitation of the study was the securities or portfolio of securities selected that was used for the study. In order to ensure there were defined boundaries for the research, I only included securities in market indices based on size and value that were publicly listed on recognized and established stock exchanges was used and specifically shares of publicly listed stocks on the NASDAQ and NYSE stock exchanges. The next delimitations were the variables or factors that I used in the regression models. This included the market premium, size or market capitalization, book-to-market ratio, momentum, profitability, and investment variables or factors. It allowed me to ensure that the results were comparable to the past and current recognized studies on valuation models in the literature. I also used time-series regression analysis and sort procedures and methodologies that were based on past research studies that would provide results that could be comparable to the current literature on valuation models.

Significance of the Study

The significance of the study was that the results could be able to provide a more robust and accurate measure of a financial security based on the size factor that can be used by financial decision makers. I pursued this study to understand better and improve the ability of market participants to buy and sell securities based on fair values that would allow the flow of capital to the necessary sectors of an economy. Access to fair trading mediums was important not only to large institutional investors but individuals who require safe and secure spaces to grow their capital and obtain returns that will enable them to contribute to the overall economy and avoid a financial crisis like in 2008 (Ball, 2009). This was also to provide a mechanism to ensure that financial markets were not just for the few or one percent or the reason for the Occupy Wall Street movement (Milkman, Lewis, & Luce, 2013).

Significance to Practice

Financial crises were not new and since World War 11 (Reinhart and Rogoff, 2008) there has been 18 crises in industrialized nations. Crisis were not only regulated to industrialized countries or regions as China has recently experienced two major crises in the last decade (Jiang, et al., 2010). Furthermore, crises were a recurring event as economic forces, regulators, and financial market participants were in flux attempting to accomplish their specific agendas and eventually lead to bubbles that end up as catastrophic financial events. For many of the stakeholders involved, they can weather the storm but those without the means like individuals who participate directly or indirectly (pension plans), this can be devastating financially. Practitioners including regulators, economists, and other stakeholders (i.e. The Occupy Wall Street Movement), there must be some transparency and assurance that markets function with some form of efficiency where there was accountability and limit irrational market movements like financial bubbles. Investors play an important role in this function since they must make financial decisions, and this must be based on a rigorous and robust analysis that can only be accomplished using the proper tools or models.

Specifically, the current tools and models should be able to have a predictive capability and be able to determine the value that was not based on speculation and errors and one factor, size, was an important consideration. Size plays an important role asset allocation and the building of portfolios that meet risk requirements of investors and allows a robust and optimal investment strategy (Bamberg, & Neuhierl, 2012). Market cap or size plays an important role in determining the value and flow of capital to firms that meet the requirements of not only investors but for a stable and vibrant economy that had positive social impacts to all in society and not just to market participants through the sustainable employment opportunities and standard of living.

Significance to Theory

Currently, there were many studies trying to identify bubbles, and how they behave so they were not necessarily avoided but managed (Kindleberger, & Aliber, 2011). In the current academic literature, there were questions by researchers whether bubbles were rational or irrational (Engsted, 2015). If rational, then current valuation models should be able to address valuation during crises and specifically to this study, the market capitalization or size should be able to determine the effects of a firm based on size. Current models like the CAPM, Fama-French three and five factor, and Carhart four factor model have been tested to determine if the models can incorporate the effects of extreme financial events but there has been limited to works in this endeavor (Bianchi, 2015).

Another significance of the study I examined was growth versus value stocks with growth stocks mainly attributed to size (small) and value stocks the book-to-market ratio (firms that were mature and usually big) in the FF model (Rehman, and Razzaq, 2015). Most researchers were trying to determine misspecification and errors within a model; this study attempted to re-examine the concept of size, and in the current literature the concept of size was only viewed from the perspective of market capitalization. Size as a description of a financial security has been found to affect valuation and could be better reflected in current models that used a different lens and not just market capitalization, and other studies have used other dimensions like total assets and enterprise value (Sehgal, & Balakrishnan, 2013). There was also the issue of how other factors like B/M and momentum (Carhart, 1997) affected the value and could duplicate the effects of the size factor. Also, size can be regarded as relative, and the current sorting methodology of categorizing size was very rough, and one dimensional and other methodology for sorting could produce more accurate results. There was also the aspect where factors could have had duplicity in the results or predictions of value and particular size and book-to-market factors. Therefore, provided me an opportunity to the development of a stand-alone two-factor model that had been noticeably absent in the literature.

Significance to Social Change

My purpose for this study was not to make a direct positive social change but to add to the current understanding of valuation models from the lens of firm size based on a different perspective than just small and large sized firms and thus indirectly contribute to positive social change. Consequently, advancing the current knowledge on valuation models, I could enable market participants to make better and more optimal financial decisions that create fairer trading of financial products on financial exchanges. If transactions were processed fairly by respective parties benefiting each party equally, then this would create a zero-sum game that would allow the flow of capital to the firms that required the funds to grow and prosper and most importantly discourage speculation and other inefficiencies that create bubbles and thus financial crisis. If markets were functioning with some form of efficiency, this could allow an economy to prosper and preserve and create full-time jobs and avoid shrinking of real wages (Warner, 2013), and would benefit all in society and not just market participants. Better valuation models could also provide some transparency and understanding to the general society or the average investor that markets were fair and equitable spaces or mediums to flow capital to firms that could benefit the needs of all in society.

Summary and Transition

The purpose of this study was not to make a breakthrough or dramatic change to the current understanding of valuation models. My purpose was to add to the current knowledge regarding valuation models that could be used in the future to create better and more robust valuation models under varying market conditions. In turn, this could help investors and in particular, individuals to make informed and rational financial decisions that could lead to more equitable and fairer trading of financial securities. Moreover, the findings would lead to more efficiency in financial markets and was not to eliminate the creation of financial bubbles but could reduce the severity of financial losses without major interventions and allow some assurances that financial markets were integral to the economy of a society to allow the flow of capital to firms that could create and preserve jobs and a sustainable standard of living.

The next chapter I examined and reviewed the past and current academic literature on valuation models. This required me to review the theoretical foundation of modern financial markets based on the functioning and the importance of financial information. The models that I reviewed were the one, three, four, and five factor models that were currently being used by practitioners and were the focus of studies in the academic literature. This was to examine how well the current models explain the cross-sectional returns of a financial security or portfolio of securities over different time periods and in financial markets from a global perspective. Also, I reviewed the field of study of behavioral finance to determine how market participants utilized financial information in making financial decisions and the importance of the use of financial models.

Chapter 2: Literature Review

In order for financial decision makers to make transactions that could optimize returns, they require the tools to determine the value or returns of an asset. This was the general problem under study and in many past studies where current valuation models do not explain consistently or reliably a security's value based on past performance as indicated by Davies, Fletcher, and Marshall (2015) in their extensive tests of various valuation models in the U.K. including the FF model. The specific problem under investigation was the effect of size in the FF model, as measured by market capitalization (cap) that used small and big cap firms (Riro, & Wambugu, 2015). The purpose of this quantitative study was to explore the understanding of the independent variables in current factor models, and specifically the size factor, to develop better factor models to determine value. Financial decision makers require better tools to make more informed financial decisions that can be used by not only by institutional or high net worth investors but by any small investor as described by Lusardi & Mitchell (2014). Financial markets should be accessible to all investors for an equitable medium of exchange for a robust economy whether locally or globally where sellers and buyers of financial products can actively transact.

Modern economies rely on financial markets to flow capital to the firms that generate wealth not only to shareholders but all stakeholders and the expansion of economic activity (Barroso, da Silva, & Sales, 2016). Proper and equitable functioning of financial markets was based on informational efficiency (Fama & French, 1970), but also requires market participants to have the appropriate tools or specifically models to determine value. In the first part of the literature review, I will examine the theories in respect to how markets function and then provide the evolution of current factor models. There was also be a review of extreme market movements or volatility and an epistemological review of the size factor and how it was currently used in multifactor models.

In the next section, I discuss the search strategy that was used and then the databases and search engines that were used in the research. Included in this section were the search terms utilized to retrieve relevant research studies on valuation models. The main part of this chapter was dedicated to the theoretical foundation and the literature review for determining the value of an asset in the current literature. At the end of this chapter, I will summarize the major themes in the current literature on factor models and the current gap that was central in this research. In conclusion, I will connect the current gap in the literature to the research methods that I examine in Chapter 3.

Literature Search Strategy

Over the course of this research, I used many library databases and search engines. The seminal literature on financial markets and valuation models were based on the original works by Eugene Fama and Kenneth French. Their works included the efficient market hypothesis in 1970 and then the FF model in 1993. Since the 70's, Fama and French have been adding to the current knowledge in finance continuously, and as recently as 2014, they updated their original three factor model to include two new factors to create a five factor model. Currently, both academics and practitioners have added to the current knowledge of valuation models, and with the rise of emerging markets and globalization many of the seminal theories have been tested internationally. The following were the list of the databases and search engines that I used for this research:

- Databases - Kenneth R. French – data library, Russell Indices, NASDAQ, NYSE, and S&P indices
- Search engines - Walden University Library, Google Scholar, EBSCO, Quantl and ProQuest
- International references - SCMS Journal of Indian Management, International Journal of Business & Finance Research, Schmalenbach Business Review, German Economic Review, and Asia Pacific Business Review

There were many key search terms that I used in the literature review, including the following: *asset pricing models, valuation models, CAPM, Fama-French three factor model, Carhart four factor model, Fama-French five factor model, factor and multifactor models, two-factor models, market premium, beta, small cap, mid-size cap, big cap, book-to-market, market-to-book, momentum, alpha, returns, financial markets, EMH, efficiency, random walk, MM theory, financial crisis,* and *Occupy Wall Street.*

Theoretical Foundation

The theoretical foundations that I used to guide this study were the efficient market hypothesis (Fama & French, 1970), random walk (Fama, 1965), Modigliani-Miller theorem (Modigliani & Miller, 1958) and the size effect. The importance of these theories to this study was that they provided a rationale and perspective of the proper functioning of financial markets and the capital structure of a firm. These theories provided a more rigorous theoretical framework or lens when examining the functioning of financial markets under extreme market volatility and to build better valuation models that can explain the effects to the price of a security.

Financial markets were essential for modern economic systems because they facilitate a means for complex transactions to occur for the underlying markets. The proper functioning of financial markets allows for the flow of capital and liquidity that was used by investors to buy companies that produce and distribute goods and services that were the basis of all human societies regardless of political systems. Fama (1970) indicated that the primary role of capital markets was to allocate the ownership of capital stock for investment decisions and resource allocations. He also indicated that the ideal was to have an efficient market where the price of a stock fully reflects all available information; this was the basis of the efficient market hypothesis (EMH). As noted by Berk and DeMarzo (2014), under EMH, all positive NPV opportunities would be eliminated as security prices reflected all available information and competition as it relates to pricing would be accurately reflected. If this was the case, then this creates issues with competition, especially investors looking for profits or returns greater than a perfect EMH. This was the ideal scenario and was not necessarily the reality of current or past financial markets. Past researchers have looked at various degrees like weak, semi-strong, and strong forms of EMH.

Informational efficiency could be of varying degrees based on information availability and interpretation. If information was publicly available to all investors at the same time and can be interpreted easily, that was a strong form of EMH (Berk, & DeMarzo, 2014). If the information was private, requires effort to retain, and was difficult to interpret, that was a weaker form of EMH. The financial crisis of 2008 called into question the efficiency of financial markets and if they were rational or inefficient or at least a very weak form of EMH. This could be significant to society because the active players or actors of the power structure (elites) must provide some semblance of transparency and organization through regulation or monitoring otherwise there would be no investors especially when no one was prosecuted for the financial crisis of 2008 (Pontell, Black, & Geis, 2014).

The subprime mortgage was the basis of a paper by Mark Rom (2009), who investigated how the credit rating agencies (CRAs) failed in the subprime mortgage crisis that led to the financial collapse when there was extreme volatility in financial markets. Less than perfect efficiency has also been observed during normal periods of market activity as indicated by Roy and Ashrafuzzaman (2015), in their study on stock prices of shares trading on the Dhaka Stock Exchange. They observed efficiency was less than perfect or inefficient, and the price multiples of a stock behaved in a trailing direction or overpriced or underpriced market prices of stocks especially in emerging markets. Drakos, Diamandis, and Kouretas (2015) observed inefficiencies in emerging financial markets and specifically in the Cypress Stock Exchange between small and big sized portfolios. The authors described this as the *lead-lag relationship*. Research conducted by Westerlund, Norkute, and Narayan (2015) on future markets showed that the use of univariate tests produces results that show inefficient markets but when using panel data confirms efficiency. For this study, EMH could need to be accounted for and an assumption that financial markets that was used in the testing exhibit a semi-strong to strong form of efficiency and any efficiencies could have limited effect on the results over the time period that was used for the analysis.

The random walk theory (Fama, 1965) postulated that stock price should change from one period to another period and the change was independent from each observation and should have had the same probability distribution to be consistent with EMH. Past empirical evidence indicated that there were varying degrees of EMH and, as indicated by Ball (1994), prices behaved like random walks and that prices were statistically random even though they appear to be moving in a particular direction. As Ball (1994) noted, there appears to be chaos rather than order, and there was no discernible economic explanation between the two states and only the statistical appearance of randomness. Lean, Mishra, and Smyth (2015) noted that if there were shocks to the prices of stocks, then there should be a departure from the long-run equilibrium or that it should not be possible to predict future prices based on past or historical prices. They found in their study a reversion back to the long run mean or stationary prices after a shock. Even though financial markets appear to follow a predictable path, in that prices rise over time, the actual path should not be predictable from one period to another. Results from Lean, Mishra, and Smyth (2015) study of five stock price indices confirmed the random walk hypothesis. The random walk hypothesis could be important in the interpretation of the results of the tests I perform on valuation models since stock prices could exhibit a random walk from one period to another even though over time appear to follow a rising path.

Mishra (2013) indicated that extreme market movements like the financial crisis in 2008 and asset bubbles could skew or under/overstate findings or more specifically the relationships of the variables in current valuation models. I will need to account for extreme market movements in the research methodology especially when using historical data during bubbles or crises during the period under study. Chen (2016) separated the periods into sub-periods to ensure the results for the time period of 2008 to 2009 or the financial crisis did not affect the results especially when many stock marks internationally plummeted. The returns and stock prices that I used in this study covered a 10-year period from 2006 to 2015 and were divided into subperiods based on the volatility index (VIX) and the market crash of 2008 or for the period 2006 to 2010 and then 2011 to 2015 to examine less extreme market conditions. During the first breakpoint (2006 to 2010) the VIX was 20.42, and during the second period (2006 to

2010) it was 23.46, that roughly made the subperiods between the average of the whole period of 20.43 (VIX, 2017).

Debt and equity of firms, regarding the effects they could have on the value of firms, have been topics of interest in recent literature. The main contribution of Modigliani and Miller in their Proposition 1 (MM #1) was that capital structure does not affect the value of the firm (Modigliani & Miller, 1958). Regardless of the amount of the debt or equity held or issued, the value of the firm was not affected. The researchers looked at uncertain streams of cash flows from investment opportunities and looked specifically at streams of profits before payment of dividends or interest. The stream of profits was then applied to shares of firms of similar classes and assume bonds were trading in a perfect market will not make the value of one firm different if it pursues a different capital structure. That was the issue of mores shares or bonds in the capital structure of a firm. More specifically, Modigliani and Miller (1958) noted there must be an equilibrium of debt and equity and that if the assumptions or relationships between any two firms do not hold true then there could be an opportunity for arbitrage. The assertions made by Modigliani and Miller (1958) could also be important as they postulated the debt to equity ratio of a firm did not have an effect on value and was a consideration in current models that use book value in determining the SMB and HML factors. The book-to-market variable in current valuation models, like the FF model, could be affected by the capital structure of an individual firm and thus its value. The capital structure could be problematic in valuing individual firms, but most researchers use more than one firm or stock when testing valuation models. As a guide and for comparison purposes, I used past studies like Sehgal and Balakrishnan (2013) to ensure reliability and validity of results.

The size effect theory holds that firms that have small market capitalization outperform firms that have big market capitalization. Lambert and Hubner (2014) examined the size factor in the FF model (Fama & French, 1993) and observed this past anomaly in the U.S. stock market or the size effect and was underestimated in their original study. Lambert and Hubner used a sorting procedure in their study of conditional rankings rather than independent rankings. Mishra (2013) also observed the size effect anomaly especially for big sized portfolios in the Indian Stock market that used the FF model. The author also noted when two factors, the size and value factors, were used jointly in a factor model produced better results than individually. The size effect was also observed by Pandey and Sehgal (2016) in the Indian stock market in their study for the period of October 2003 to January 2015. They controlled for penny stocks and found that returns decreased with the size of a stock even when they used different determination of size based on total assets, net fixed assets, net working capital, net sales and enterprise value. They found the presence of nonsynchronous trading bias and reverse seasonality effect. The author's observed that market, size, value and business cycle factors explain size effect while liquidity and momentum factors have little role in this process for the Indian stock market. The size effect anomaly was an important consideration in the testing of valuation models and required a finer size classification and weight balances on small/big portfolios to reduce specification errors. The size effect anomaly asserts small caps outperform big caps but ignores comparison or the relative performance of small and big cap stocks to mid-caps.

There were other anomalies that I reviewed in the financial literature that must be accounted for like the January effect. In past research, the January effect was a systematic pattern of security prices where the mean returns for the month January were higher than the means for the other months of the calendar (Patel, 2016). The January effect was contrary to the EMH that assumed that security prices fully reflected all available information at any time and any random price changes like monthly systemic patterns and were not consistent with EMH. The January effect was found to exist along with the size effect, and He and He (2011) along with Patel (2012) noted that this effect was before 1986 and did not continue after that date. The January effect was reaffirmed by Chen (2016) for international stock returns for the period from January 1997 to December 2014. Both research studies noted that January effect could have shifted to November and could be due to seasonal shifts. Shifts in stock returns were examined by Friday and Hoang (2015) and found positive returns in April and negative returns in July in the Vietnam Stock Exchange. Another seasonality anomaly was noted by Karki and Ghimire (2016) when they performed a seasonality check in their study for the month of October during the time of national festival Dashain for the Nepalese stock market. Anomalies like the January effect could affect results and review of seasonality, and other anomalies need to be accounted for in the findings.

Literature Review

The foundational valuation model I reviewed and was the basis of all current factor models was the single-factor Sharpe-Lintner (Sharpe, 1964; Linter 1965) or CAPM. The model was based on asset's sensitivity to non-diversifiable risk or the quantity beta (β) and this theoretically risk-free asset was used to determine the expected return on a stock. CAPM has been expanded by researchers with the addition of new factors or supplementary risks other than systematic or market risks. The Fama-French (1973) three factor model was an example of a multifactor model that included two new factors that included market capitalization (size) and the book-to-market ratio (B/M) to create a model with three factors. The model was expanded when Carhart (1997) added a fourth factor that included momentum or the Carhart four factor model. Fama-French (2014) added two new factors to their model and was profitability, and an investment factor for the Fama-French five factor model. Recent advancement by both practitioners and academics have added many more factors and in a recent study by Hsu (2014) described this phenomenon as the *factor zoo* with models having 80 factors and even as high as 600 factors. From the analysis of these models, many of the new additional factors produced zero or negative premia out-of-sample and only produced results slightly better than flipping a coin. A very important and noticeable absence or gap in the current literature on multifactor models was a stand-alone two-factor model and was the purpose of this study. The following were the regression equations of a one factor, four factor, and five factor models. The main three factor model was already described in chapter 1.

Capital Asset Pricing Model (Sharpe, 1964; Linter 1965) – Regression equation 2

$$Rit = Rft + \beta i(Rmt - Rft) + \varepsilon it, \qquad (2)$$

Table 2

Variable Descriptions - CAPM

Term	Description	
Rit	Rate of return on a security *i* during time *t*	Depedent variable
Rft	Risk free rate *f* during time *t*	Independent variable
βi	Beta measure of systematic risk of a security *i*	Coefficient
Rmt	Market return *m* during time *t*	Independent variable
(Rmt − Rft)	Market premium (Market return *m* minus Risk free rate *f* during time *t*)	Independent variable
εit	Error term of the security *i* during time *t*	

Carhart Four Factor Model (Carhart, 1997) – Regression equation 3

$$Rit = Rft + \beta i(Rmt - Rft) + siSMBt + hiHMLt + wiUMDt + \varepsilon it \qquad (3)$$

Table 3

Variable Descriptions - Carhart Four Factor Model

Term	Description	
Rit	Rate of return on a security *i* during time *t*	Depedent variable
Rft	Risk free rate *f* during time *t*	Independent variable
βi	Beta measure of systematic risk of a security *i*	Coefficient
Rmt	Market return *m* during time *t*	Independent variable
(Rmt − Rft)	Market premium (Market return *m* minus Risk free rate *f* during time *t*)	Independent variable
SMB t	Market Capitalization - Small minus Big during time *t*	Independent variable
si	Linear regression of the defined SMB factor *s* of security *i*	Coefficient
HMLt	Book-to-Market - High minus Low during time *t*	Independent variable
hi	Linear regression of the defined HML factor factor *h* of security *i*	Coefficient
UMDt	Mometum - Winners minus Losers during time *t*	Independent variable
wi	Linear regression of the defined UMD factor factor *w* of security *i*	Coefficient
εit	Error term of the security *i* during time *t*	

Fama-French Five Factor Model (Fama & French, 2014) – Regression equation 4

$$Rit = Rft + \beta i(Rmt - Rft) + siSMBt + hiHMLt + riRMWt + ciCMAt + \varepsilon it \quad (4)$$

Table 4

Variable Descriptions - Fama-French Five Factor Model

Term	Description	
Rit	Rate of return on a security *i* during time *t*	Depedent variable
Rft	Risk free rate *f* during time *t*	Independent variable
βi	Beta measure of systematic risk of a security *i*	Coefficient
Rmt	Market return *m* during time *t*	Independent variable
(Rmt − Rft)	Market premium (Market return *m* minus Risk free rate *f* during time *t*)	Independent variable
SMB t	Market Capitalization - Small minus Big during time *t*	Independent variable
si	Linear regression of the defined SMB factor *s* of security *i*	Coefficient
HMLt	Book-to-Market - High minus Low during time *t*	Independent variable
hi	Linear regression of the defined HML factor factor *h* of security *i*	Coefficient
RMWt	Profitability - Robust minus Weak during time *t*	Independent variable
ri	Linear regression of the defined RMW factor factor *r* of security *i*	Coefficient
CMAt	Investment - Conversvative minus Aggressive during time *t*	Independent variable
ci	Linear regression of the defined CMA factor factor *c* of security *i*	Coefficient
εit	Error term of the security *i* during time *t*	

CAPM: Single Factor Model

CAPM has been criticized by many researchers mainly based on how to calculate beta based on the appropriate historical data and also its usefulness that had led Frazzini and Pedersen (2014) to introduce new forms of beta or as they noted *exotic betas*. Initially, CAPM was developed to be used to create portfolios with optimal expected returns based on per unit of risk or the Sharpe ratio. Dependent upon leverage or unleveraged financing, a portfolio can be optimized according to an investor's risk preference or profile. Leverage was not a luxury afforded to most investors and resulted in overweighting of mutual funds in a portfolio that had given rise to ETFs to achieve the optimal or efficient allocation portfolios and created or tilted portfolios to high-beta assets that required lower risk-adjusted returns than low-beta assets that require leverage. Based on CAPM, the security market line for U.S. stocks was too flat and with leverage or borrowing provided a better explanation of market returns when used in the model. In their study, the authors proposed the use of factors like size, value, and momentum and to bet against beta (BAB) as an optimal strategy. They used data from 20 countries and used a long-time horizon (1926 to 2012) and found that the security market line was flatter than in past works and the one new factor of BAB produced higher returns than other factors like value, momentum, and most importantly for this study size.

Fama-French Three Factor Model

The FF model was the most studied and researched model and the current focus in testing of a model outside of the U.S. Mishra (2014) tested the FF model and used data from the Indian Stock Market and again found beta was not reliable and only explained 70 percent of the returns and the other 30 percent explained by other factors. Factors related to firm specific characteristics provided a better explanation of return behavior that included size and B/M ratio. In particular, as it related to size, the second factor or SMB (small minus big) model was found to be significant for big sized portfolios. Also, when there were two factors (market premium and size) and used jointly produced better results than individually. For the Indian market, models that used all three factors or two-factors rather than the use of individual factors improved the performance of the model most interestingly suggested there could be an opportunity for a two-factor model. Most importantly, this provided more breadth in the current research when applied to models that were developed in the U.S. to other foreign markets and provided better explanatory power in the explanation of returns.

Three and Four Factor Models

Other studies like Artmann, et al., (2012) also examined the FF model along with the Carhart four factor model outside the U.S. market and specifically in Germany. Another unique aspect of their study was that they tested the models based on industry and used different procedures for sorting assets by the size and B/M factors. The findings from their study were that the additional factors like size, value, and momentum did not necessarily account for the risk in returns of the portfolios that they had developed. They proposed that size and value factors could be proxies for other aspects to returns and in particular default risk or the premium for holding assets based on bankruptcy costs associated with negative financial shocks or extreme market volatility. I noted the proxies as a serious consideration when testing models in my study to understand default risk as a proxy or an issue to size in valuation models. The one other finding they had found for the German market was that the Carhart four factor model produced the best results and was important since there could be correlations between factors and for this study how size could be influenced or influence other factors.

Similar to Artmann, et al., (2012) findings, Trimech, and Kortas, (2009) found that the Carhart four factor model did perform well especially with the addition of the momentum factor. The momentum factor described the tendency for the price of a stock that was rising to continue to rise or if declining to decline represented in the model by WML (Winner minus loser). This was based on the movement of a stock price over a short period of time like monthly but would not be applicable over long periods. Trimech and Kortas, (2009) tested the model based on a single scale perspective for the French market and used wavelet functions or mathematical functions that split a function into different scale components to a specific frequency range. They found that all the four risk factors explained the returns based on data from the French market and were significant for the medium and long-run time horizons. The importance of their study was they provided a different methodology for testing valuation models that used wavelet functions.

Five Factor Model

Fama-French had provided many of the most important studies in the last 40 years not only on valuation models but also financial markets. Recently, Fama & French (2014) updated their original FF model and created a new five factor model by adding two new factors profitability, and investment. They noted that in their original model market capitalization (size of a firm) tended to reflect the size effect or smaller firms had higher returns than bigger firms. The next factor, B/M or value stocks tended to show that value stocks or securities with low B/M tended to do better than the market as a whole. Consequently, these two aspects of the size effect and value stocks have been embedded in the current literature and examined, but not fully explained in all time periods or markets or time and space.

The addition of profitability by Fama and French (2014) was based on the notion that more profitable firms should outperform less profitable firms. The investment factor was based on the assumptions that profits from operations plowed back into investments (i.e. capital expenditure, market expansion, acquisitions, etc.) should determine the overall value since reinvestment could generate future revenues and thus increase returns. When testing the new five factor model, Fama and French (2014) found that there were problems with the number of factors used and an issue of parsimony (less could be better). The main problem identified in their study was the valuation of small sized stocks where they tend to have high investment despite low profitability that made determining or describing patterns of returns difficult.

Market Capitalization Factor or Size

Common to all the multifactor models that were examined was that used market capitalization or the size factor. Lambert and Hubner (2014) examined this factor along with the B/M factor. The size effect has long been an anomaly that had been observed in the U.S. market where small stocks tended to outperform big stocks and for value stocks (high B/M ratio) tended to outperform growth stocks (low B/M ratio). Another anomaly noted was the momentum effect where significant gains could be realized from long positions in persistent winner stocks and short positions in loser stocks. The authors found that in examining these anomalies using the FF model that the size effect was underestimated, and the B/M factor was overestimated. The profitability and investment factors had not been studied extensively and were required to be included to ensure reliability and validity in the statistical testing. From the current studies like Lambert and Hubner (2014), these anomalies did not appear to be consistent over different time periods or over different markets globally and most notably in emerging markets. There were also firm specific issues based on industry and transactional costs related to other financial considerations. The main aspect of the size effect anomaly was that small sized stock performance or returns were compared against large sized stocks but no comparison to midsize stocks. Consequently, methodology in testing and specifically the sorting of factors that included midsize stocks that determined the size effect were not done in the current studies.

Asset Valuation Models

Multifactor models were one type of asset valuation models that were specifically designed to value a stock or portfolio of stocks. The asset, stock or equity of a firm that were valued were publicly listed and traded on a recognized stock exchange. There were other types of asset valuation models in the current literature that provided a better understanding of valuation of financial assets. I reviewed the following on the current knowledge on other valuation models and were the Discounted Cash Flow model, Weighted Average Cost of Capital, international assets, private equity valuation, and Options Pricing.

Discounted Cash Flow and the Weighted Average Cost of Capital. The valuation models that were previously discussed were based on the current literature on factor models but their other types of models and tools that were used and the following was a review of some of the other methods currently employed. Factor models rely on one (CAPM) or multiple factors that can explain market phenomena or the price of a security or portfolio of securities. Factors models that were tested used multiple regression analysis on the variables in the models and employed both analyses as to the relationships between the independent variables and to the dependent variable. The data collected on the dependent variable, expected returns and the independent variable, factors, were based on historical information. A traditional approach to value assets, investments, or projects had been the Discounted Cash Flow (DCF) where the future stream of cash flows (both inflows and outflows) or as noted by Hasan, Zhang, Wu, and Langrish, (2016) as costs and benefits. The future cash flows were then discounted based on a discount rate or the cost of capital and were derived from the value of the firms or the rate of return required by the shareholders of the firm (Gregory, Tharyan, & Whittaker, 2014). The cost of capital was determined using factor models that provided the expected return of an asset based on the cost of equity of an asset and was added to a diversified and efficient portfolio (Berk & DeMarzo, 2014). In essence, factor models were tools best used to measure the value of equities, stocks, and portfolios however it did not consider the cost of debt and did not allow for firm-specific risks and only considers systematic risk.

Examples of systematic or market risks were shocks that were macroeconomic like interest rate shocks, commodity price shocks, and inflation shocks. Systematic risk affects the majority of firms and could affect some firms more than others and was dependent on the exposure by each firm. Firm specific risks were particular to a firm, and an investor could be able to diversify away these risks through the creation of efficient portfolios. Gregory, Tharyan, and Whittaker, (2014) provided an example of systematic risk and firm-specific using the recent Deepwater Horizon accident that affected BP and was firm-specific and the collapse of Lehman Brothers which was economy-wide or systematic. The authors noted that an investor could have avoided the losses incurred by BP with the oil spill since this risk was specific to the firm by investing in other firms but the collapse of Lehman brothers was unavoidable since this affected many firms or was economy wide and could not be diversified. The use of factor models were tools that best used in the creation of portfolios would diversify firm-specific risk but the of DCF would be more appropriate for the determination of value especially with the examination of value based on firm-specific risks.

Factor models only used the equity of a firm but debt could also be an important consideration in the determination of value. A presumption by Modigliani and Miller (1958) was that capital structure did not affect the value of a firm or specifically debt should not be a consideration in determining value. Others have noted and utilized tools that do consider debt and one tool, the weighted average cost of capital (WACC) that took into account both the debt and equity of a company to determine the optimal capital structure (Krueger, Landier, & Thesmar,2015). The main difference between factor models and in particular DCF was that the use of WACC in DCF was mostly used in valuing capital budgeting or internal financial decisions to determine the optimal mix of debt and equity to maximize value while factor models were mainly used for valuing equity.

International Asset Valuation. A current trend in the literature was to examine valuation models for assets from an international perspective that included political risk, liquidity and exchange rates. Baltzer, Stolper, and Walter (2013) examined the current bias of investors to overweight regionally close stocks that did not extend beyond domestic borders which reduced the ability for investors to value assets and optimize returns. One inherent risk as indicated by Bekaert, Harvey, Lundblad, and Siegel, (2016) was the determination of the value of assets internationally and the potential of political risk. Political risk was when government actions would affect the performance of a firm and was not only for the firms conducting business in their home countries but also for foreign investors. Bekaert et al. (2016) included the effect of political risk with the use of a sovereign spread through time series, and cross-country variation spreads and used a panel regression model that included other risks like liquidity and macroeconomic risk factors. They found that there was home country bias by investors and reduced the potential for diversification by investors that affected the ability to reduce systemic risk and to optimize returns and could be a form of inefficiency contrary to EMH. Liquidity was another major concern for valuing assets internationally, and liquidity was the degree or efficiency that an asset was bought or sold that did not affect the price of an asset. Geromichalos and Simonovska (2014) examined liquidity in their two-country search-theoretic model and like Bekaert et al. (2016) the home bias of investors, but also found high turnover rates of foreign assets and did exhibit desirable liquidity properties but over time the returns were unfavorable. Currency exchange was also another area of importance not only for valuation of assets but also for firms that traded or conducted business in more than one nation. Bénétrix, Lane, and Shambaugh, (2015) examined the effects of currency exchange from the period of 2002 to 2012 and noted during the 2008 financial crisis there was larger currency exchange risks comparative to the preceding years and continued afterward until the end of their study to 2012. They also found that the foreign currency positions of firms mattered especially during the crisis and contributed to currency-induced valuation losses. Political risk, liquidity and exchange rates could affect the valuation of financial assets from an international perspective since the stock of a firm could be traded on one national exchange but conducted business globally.

Private Equity Valuation. Valuation of private companies was difficult because they were not traded on recognized financial markets or were required to disclose financial information. In a paper written by Jenkins and Kane (2006), they noticed the lack of analysts following private firms and also limited independent earnings forecasts. They examined the current valuation methods for private firms such as book value model (BVM), earnings capitalization model (ECM), residual income model (RIM) and the excess earnings method (EEM). BVM used the book value in the determination of value and the benefit stream but had not taken into consideration the valuation of intangibles or the historical costs of assets. The ECM discounted future dividend payouts and was based on a firm’s earnings. A hybrid measure was RIM and used both the assets and income as a measure of value based on historical accounting information but did not measure future values or intangibles. The final measure was EEM and was similar to RIM but took into account intangibles like goodwill. Jenkins and Kane (2006) tested each method as to its accuracy by sampling data from of the eight largest, non-regulated, nonfinancial two-digit SIC industry groupings. They found that EEM provides the most accurate valuation compared to the other methods and there was a link between EEM and

RIM. The author's suggested that an important consideration for valuing private firms were issues involving taxation and other legal implications that were outside the scope of these models.

Another method to value private equity firms was discussed in a paper by Sharma (2012) using comparable analysis. They looked at comparable firms that had accessible or available financial information which they used for the firm under investigation. Sharma (2012) specifically looked at volatility, the cost of equity, and the value of equity. The author could not find a comparable firm; they would use an average for comparable firms. An interesting aspect of the author's valuation was that private businesses go through various phases starting with infancy or growth phases to the mature phase. The importance of valuation of private firms was when private firms go public or issue an Initial Public Offering (IPO), these firms tended to be listed as small cap firms when becoming a publicly traded security. Rose and Solomon, (2016) also found that when they do become public, they tended to underperform and either were delisted at a high rate or remain as smalls caps. New firms that became publicly listed was an important consideration when examining the effect of small caps in valuation models since they could consist of once private firms that were delisted from an exchange and the turnover of listing and de-listing was taken into account in the creation of portfolios that consisted of small caps.

Options Pricing and Asset Valuation. An option or a financial security that gives the right but not the obligation to buy or sell an asset where the value of the option was determined by an underlying asset like a stock, bond, index, commodity, or currency. An option or referred to as a financial derivative was difficult to value until the introduction of the Black-Scholes (BS) model in 1973 (Black and Scholes, 1973). There were two types of options; the first type was an American option that gave the buyer the right to exercise their option at any time before it expires whereas a European option can only be exercised at a specified future date. The BS model used a formula that was based on an ideal condition for both the underlying stock and the option. The assumptions or conditions for the BS model where short-term interest rates were known and constant, random walk holds true for the price of the stock, no dividends, no transaction costs, ability to borrow any amount to hold the security, and no penalties for short selling. The model enabled the pricing of an option either by holding a long or short position in an asset and was referred to a call or put option respectively. Since the introduction of the BS model, there has been debate as to the robustness of the model in terms of limitations and accuracy. One of the major limitations of the BS models was that it was used to price only European style options that can only be exercised at a fixed maturity date. As indicated by Nwozo and Fadugba (2014) the BS model was very broad and did not account for the complexity of today's options and in particular American style options and other features like dividends. American options can be exercised before the maturity date and many stocks do pay dividends. Another criticism of the model was discussed by Yousuf, Khaliq, and Kleefeld (2012) and that the model did not include transactional costs on the pricing of options. Overall, the simplicity of the model which only required five input parameters to derive the option price made it practical and easy to be used especially when the expected return of the stock was not required (Berk & DeMarzo, 2014). Also, the BS model was based on historical information and did not consider the projections of future value and the volatility of markets. The BS model simplicity could also be the downfall of the model and was the basis of the current discussion of new option pricing models.

A premise of the BS model was that the price of the option could not affect the price of the underlying asset. Also, the assumption in the BS model, the underlying stocks traded perfectly liquid markets. These issues with the BS model was discussed by El-Khatib and Hatemi-J (2013) as they discussed how the financial crisis demonstrated that markets were not perfect and could be illiquid. During the financial crisis of 2008 the pricing of options involved random jumps in the pricing of the underlying stock and their paper studied the jump-diffusion structure to an option pricing model. The types of jumps they investigated were when stock prices were pushed down, and when they were pushed up. They proposed the use of a generalization of the Black-Scholes pricing partial differential equation (PDE) that included these jumps in illiquid markets and provided the validity of the model that used a mathematical proof.

Ideally, stock options could not affect the price of the underlying security, or specifically the stock but Hu (2014) found that information on stock price movements can be found from the trading of options and also where investors could migrate from trading directly of the stock to the options markets instead. The information derived from option order imbalances (excess of either buy or sell order) usually only last for a couple of days, but there could be a price discrepancy for a few weeks later and was found to be more pronounced during periods of financial uncertainty. Chang, Hsieh, and Lai, (2013) also found that investors with options or future trades had a significant influence on stock price for before a stock market opened, but was not an extreme or lasting effect to the price of a stock. An important finding by Hu (2014) was the impact of the price of stocks was stronger for widely held small cap firms and could be a future area for consideration when examining valuation models to consider external factors based on trading volumes for small caps on option markets.

Concept Map

The knowledge and organization of the proposed study were presented in a Concept Map in Figure 1 and was based on Novak (2006) article on the graphical representation of a proposed research study. The main theory that was the basis of today's financial markets was the efficient market hypothesis, but other theories were also presented and where the random walk theory (Fama, 1965), and the size effect anomaly. The random walk theory purposed that financial market movements were random and not predictable even though they followed a path and rose over time. The rational expectations theory assumed investors made choices based on their rational decision making taking into account of all available information and past experiences and was based on behavioral finance. These were the basis for not only how markets function or their purpose, but allowed the development of models to determine the price of an asset and at the next level of the Concept Map were the four main current pricing models and were CAPM (Sharpe, 1964; Linter 1965), Fama-French three factor (Fama & French, 1993), Carhart four factor model (Carhart, 1997), and the Fama French five factor model (Fama & French, 2014).

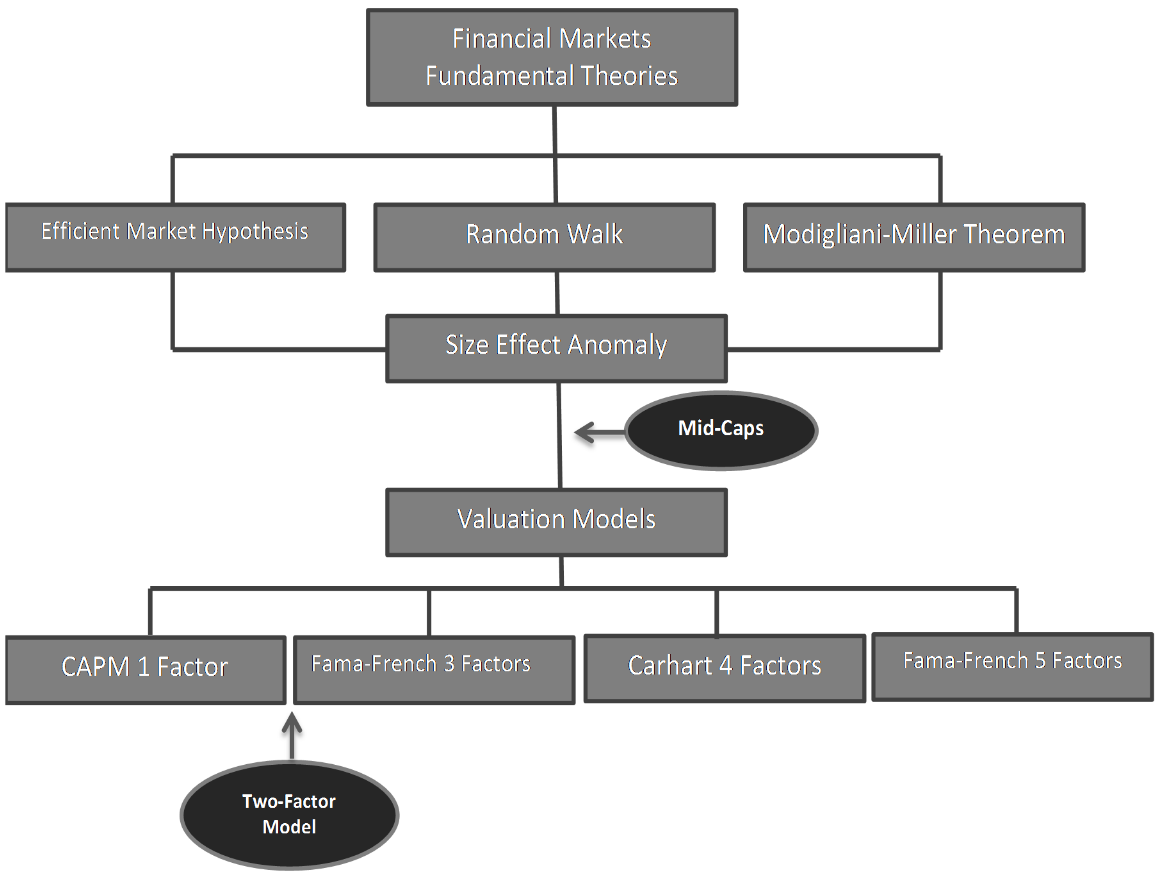

Figure 1: Concept Map

Gap in the Literature

A noticeable gap in the literature was the exclusion of midsize cap securities in the market capitalization or size factor in the current multifactor model. Current multifactor models utilized small and big stocks in the determination of the size factor based on the size effect. The size effect anomaly was where small cap stocks outperformed big caps and was shown to be statistically significantly in explaining stock returns originally by Banz (1981) for the period 1936-1977. The proposition put forth by Fama-French (1993), and current academics was to include as an independent variable based on the effect of size or the returns of a security or portfolio of securities because of past observation where small cap stocks outperform big caps. Current studies by He and He (2011), Patel (2012) and Chen (2016) had found that the size effect did not currently exist after the mid-1980s. However, other studies had shown that in international markets the size effect anomaly still existed, and De Moor and Sercu, (2013) noted that used a finer classification of size with only the smallest decile stocks provided a better lens to view the effect of small caps outperforming big caps. Van Dijk, (2011) had proposed that there was a disconnect between theoretical models and empirical evidence that the size effect was a result of systematic risk that was endogenous. This new size factor had mixed results in current studies since current valuation models were being tested in financial markets internationally and the degree of market efficiency could affect results. Most current research had found that the size factor provided a greater explanation of returns than the just one factor or the market premium (Beta) and the current gap in the literature was that the current size factor could not be represented completely since it had not included mid-cap stocks.

The size factor including mid-caps. This new size factor proposed by Fama-French (1993) was represented in by the size factor in their FF three factor or SMB or small minus big that provided the size effect anomaly or more generally the effect of size on returns of a security. However, if the result of the SMB factor was negative then big cap stocks have higher returns (Panta, Phuyal, Sharma, & Vora, 2016) and the importance of the size factor could not be the size effect anomaly but how size affected or explained returns. Primarily, the size factor should have indicated the effect of market capitalization over the period of the regression analysis, but the use of only small or big caps only explained the size effect anomaly and not the size in general. Inclusions of mid-cap stocks could have provided a better understanding of the effect of size. It was proposed the inclusion of mid-caps to show a finer explanation of size in current models with the expansion of the existing factor with the inclusion of mid-caps. If the results were negative, then the small size effect was not present for the period of the analysis since mid-cap and big cap stocks would have higher returns than small caps and if positive then a smaller capitalized stock did not affect returns than bigger capitalized stocks. The omission of mid-caps from the size factor variable could only have provided the effect of size as it related to small or big caps or the size effect anomaly. The inclusion of mid-caps could had provided a better finer explanation of size as it related to returns and the endogenous systematic risk nature of the size of a security to other securities within the financial markets that they were actively traded.

The new size factor was represented by SMMDMB or small minus mid minus big caps. The change in the acronym was to avoid confusion with the original SMB acronym as indicated in formula 3 to the following new formula as follows:

Small minus Mid minus Big (SMMDMB) – Regression equation 5

$$Rit = Rft + \beta i(Rmt - Rft) + siSMMDMBt + hiHMLt + \varepsilon it \quad (5)$$

Another assumption made by the expansion of the one factor model (CAPM) by Fama-French (1993) was that small stocks with a high book-to-market ratios or value performed badly and were vulnerable to financial uncertainty or distress as indicated by Panta, Phuyal, Sharma, and Vora, (2016). Conversely, if there was a low book-to-market ratio, then the security or portfolio of securities should earn positive returns than those of high book-to-market ratio stocks. Stocks on the Bangladesh's Dhaka Stock Exchange (DSE) were studied by researchers Hasan and Kamil (2014) and they found that low book-to-market ratio stocks did outperform high book-to-market ratio stocks. This was referred to as the value of a stock based on the book-to-market ratio. The value factor was the third factor or the independent variable based on the book-to-market ratio. The value factor included two classifications of high and low, but when used in the size factor the book-to-market ratio was high, medium, and low ratios. Each factor used both market capitalization and value in the creation of portfolios and represented each independent variable. The pair groupings utilized the two-factors of market capitalization and book-to-market (B/M) and were respectively small, midsize, and big caps and low, medium, and high B/M. To include midsize caps, I required nine groupings of market capitalization was used for size and B/M or small/low (SL), small/medium (SM), small/high (SH), midsize/low (MDL), midsize/medium (MDM), midsize/high (MDH), big/low (BL), big/medium (BM), and big/high (BH). Formula 6 was the current SMB factor with six pair groupings, and next was the new SMMDMB factor with nine pair groupings that included mid-caps and was represented by formula 7. Each size classification was divided by three and the market capitalization was divided by the book-to-market ratios.

Small minus Big (SMB) – Independent variable equation 6

$$SMB = (S/H + S/M + S/L)/3 - (B/H + B/M + B/L)/3 \quad (6)$$

New Small minus Mid minus Big (SMMDMB) – Independent variable equation 7

$$SMMDMB = (S/H + S/M + S/L)/3 - (MD/H + MD/M + MD/L)/3 - (B/H + B/M + B/L)/3 \quad (7)$$

Two-factor model. Another gap in the literature that was the absence of a stand-alone two-factor model. The foundational current valuation models included a one factor CAPM model (Sharpe, 1964; Linter 1965), the Fama-French three factor model (Fama & French, 1993) and Carhart four factor model (Carhart, 1997) but no stand-alone two-factor model. The one factor model (CAPM) did not capture risk premium fully by beta (Panta, et al., 2016) and Banz's (1981) original study also showed that another factor along with beta together could be statistically significant that was consistent with a two-factor model. Also, Mishra (2013) noted when there were two-factors that were used jointly produced better results than individually. Fama and French (1998) also noted that testing a two-factor model that only included the value factor provided a better explanation of returns if there were a wider spread of book-to-market or included stocks between the small to the mid-cap range. Fama and French (1998) indicated that a two-factor model was better for the global market or international stocks. A comprehensive review of the literature was undertaken to determine if there were other two-factor models other than current multifactor models or for other financial assets and were for mortgages (Downing, Stanton, & Wallace, 2005), Growth Value Two-Factor Model (Yeh & Hsu, 2011), option pricing (Babaoglu, Christoffersen, Heston, & Jacobs, 2016), and commodity derivatives (Lai, & Mellios, 2016). The use of two-factors had not been put forth as a stand-alone model in the current literature for asset-pricing for securities, but had been noted and studied and the proposed two-factor model that included mid-cap stocks could allow for a further understanding of multifactor models or the current gap in the literature.

The proposed new two-factor consist of the market premium or beta and the size factor. The new two-factor size model was described in Formula 8 and consisted of the new size factor that included mid-caps and represented by SMMDMB or small minus mid minus big caps.

Two-factor size model – Regression equation 8

$$Rit = Rft + \beta i(Rmt - Rft) + siSMMDMBt + \varepsilon it \tag{8}$$

As indicated, the new SMMDMB factor included mid-caps as in Formula 7 where each market cap (small, mid, and big) was divided by book-market-ratios of low, mid, and high ratios. Interestingly, to determine book-to-market ratio required the use of market price or where the book value of a security was divided by the market price of a stock or the denominator (Barillas & Shanken, 2015). The book value or the equity was on the balance sheet at the end of the previous year divided by the market value at the end of the current year (Zhang, 2013):

Book-to-market ratio = Book value / Market Value (9)

Zhang (2013) described the importance of the skewness of stocks with low book-to-market ratios were positive in their returns and described them as glamour stocks while others have described them as growth stocks compared to stocks with high book-to-market or considered value stocks (Fama & French, 2012). This was the value factor or HML where portfolios were created using small and big cap stocks divided by high and low book-to-market ratio stocks and again absent or the effects of stocks with medium book-to-market ratios that were used in the SMB factor (Panta, et al, 2016).

High minus Low (HML) – Independent variable equation 10

HML = (S/H +B/H)/2 - (S/L+B/L)/2 (10)

If medium book-to-market ratios and mid-cap stocks were used in the HML formula, then there would be duplication in the formulae of the new SMMDMB factor as indicated in Formula 7, therefore, furthering the proposition of two-factor model see Formula 8.

New High minus Medium minus Low (HML) – Independent variable equation 11

HML = (S/H +S/M +S/L)/3 - (MD/H +MD/M +MD/L)/3 - (B/H+B/M+B/L)/3 (11)

One more aspect of the book-to-market ratios was the repetition of the use of the price of the stock in calculating both the book-to-market ratio and market capitalization. In the book-to-market ratio, the book value was divided by the price of the stock, and for market capitalization, the price of the stock was multiplied by the outstanding shares. For both the size factor and value factor, there was no inclusion of midsize caps, and for only the value factor there was no inclusion of medium book-to-value ratio even though it was used in the size factor. The gap in the literature was there were no two-factor models and this was investigated with the use of a two-factor model based on size as the second factor that used portfolios that also took into account book-to-market ratios was to provide better understanding of multifactor models and a summary of the formulae in this section was provided in Figure 2 – Mid-Caps and Two-Factor Size Model.

Fama-French Three Factor Model

$R_{it} = R_{ft} + \beta_i(R_{mt} - R_{ft}) + s_i\,\underline{\mathbf{SMB}}_t + h_i HML_t + \varepsilon_{it}$

where, the size factor (SMB) and the value factor (HML) are:

SMB = (S/H+S/M +S/L)/3 - (B/H+B/M+B/L)/3
HML = (S/H+B/H)/2 - (S/L+B/L)/2

S = Small capitalization	H = High book-to-market ratio
B = Big capitalization	M = Medium book-to-market ratio
	L = Low book-to-market ratio

Market Capitalization and Book-to-Market Ratio

Market Capitalization = Price of stock x number of outstanding shares
Book-to-market ratio = Book Value/Market Value (Price of stock)

Revised FF Three Factor Model Including Mid-Caps

$R_{it} = R_{ft} + \beta_i(R_{mt} - R_{ft}) + s_i\,\underline{\mathbf{SMMDMB}}_t + h_i HML_t + \varepsilon_{it}$

where, the new size factor (SMMDMB) and the value factor (HML) are:

SMMDMB = (S/H+S/M +S/L)/3 - **(MD/H +MD/M +MD/L)/3** - (B/H+B/M+B/L)/3
HML = (S/H+B/H)/2 - (S/L+B/L)/2

S = Small capitalization	H = High book-to-market ratio
MD = Mid capitalization	M = Medium book-to-market ratio
B = Big capitalization	L = Low book-to-market ratio

Two-Factor Size Model

$R_{it} = R_{ft} + \beta_i(R_{mt} - R_{ft}) + s_i\,\underline{\mathbf{SMMDMB}}_t + \varepsilon_{it}$

where, the size factor (SMMDMB) is:

SMMDMB = (S/H +S/M +S/L)/3 - **(MD/H +MD/M +MD/L)/3** - (B/H+B/M+B/L)/3

S = Small capitalization	H = High book-to-market ratio
MD = Mid capitalization	M = Medium book-to-market ratio
B = Big capitalization	L = Low book-to-market ratio

Figure 2: Mid-Caps and Two-Factor Size Model

Summary and Conclusions

The literature review examined the current foundational theories of financial markets. This included the EMH, random walk, Modigliani-Miller theorem, and the small size effect anomaly. This was followed by a more in-depth review and development of current valuation models that included the CAPM or one factor model, FF model, Carhart four factor model, and the Fama-French five factor model. In the current literature, there was no two-factor model and was a gap in the current literature. The common factor of all these models was market capitalization or size of a financial security or stock and how only small and big sized stocks were used in the determination of this factor and where midsized market cap stocks were not used. This was the other gap in the current literature and was an area of examination.

In the next chapter, I reviewed the research methods that was used in the study of valuation models. I also included the proposed research design and the rationale for this design and was based on the empirical nature of valuation or the price of a security or portfolio of securities using a two-factor and including mid-caps in current models. In addition, I included a review of the variables that were tested to include the independent variables or the factors used in current valuation models and the value of security or portfolio securities or the dependent variable. The testing of the models was discussed as the study used multiple regression analysis followed by the data analysis plan. The final sections I reviewed the threats to validity including internal, external, and construct validity concluding with a brief summary of the ethical considerations.

Chapter 3: Research Method

The purpose of this quantitative study was to test current multifactor models and examine and understand the size factor to produce better valuation models. The main model that I tested was the FF model, that included three factors or independent variables and were market premium, market capitalization (size), and book-to-market ratio. The dependent variable was the returns or value of a security or portfolio of securities. The independent variable that I focused on was the size factor, or market capitalization, which was currently constructed using small and large market capitalization securities. There were many multifactor models but noticeably absent from the current academic literature was a stand-alone two-factor model. The purpose of this study was to review and test current models and also a two-factor model that utilizes midsized capitalized securities. This could provide greater confidence in financial markets and become more accessible and a fair mechanism for the of flow capital in a robust economy that could benefit society as a whole and not just for those with the means and knowledge.

The following section begins with the research design and rationale, followed by the methodology that I used in this study. This included an examination of the variables in the factor models and constraints of the design. I also included the population, sample size, scaling, and data analysis. Also discussed was validity that included construct, external, and internal validity. The final section, I will discuss the ethical considerations with the research design with a summary of the research methods that were used in the study and a brief transition to the next chapter.

Research Design and Rationale

The goal of this study was to address the inability of current factor models to determine value accurately. I collected secondary data from recognized and public sources and used regression analysis to assess the viability of the two-factor model and included mid-caps in current valuation models. The main valuation model I tested was the FF model. The independent variables in the FF model were the market premium, market capitalization, and book-to-market and were referred to as factors. The dependent variables were the returns or the value of the security or portfolios of securities being determined. Other models that I reviewed were the one factor model (CAPM), Carhart four factor model, and the Fama-French five factor model. The Carhart four factor model includes another independent variable for momentum, and the Fama-French five factor model includes the factors of profitability and investment. I reviewed the four and five factor models but did not perform regression analysis on these models since the focus was on the FF model and the size factor that was included in all the multifactor models. The FF model also included the book-to-market factor and was also referred to as the price-to-book factor dependent on the study or academic paper.

The research design I used was based on the nature of the variables used in the study that was ultimately used for an orderly and far transacted price between a buyer and seller of a security. The rationale for the quantitative research design of this study was the empirical nature of the calculations, variables, and relationships of the units of analysis for the proposed two-factor model and the use of mid-caps in current models.

Multiple regression tests were performed and used historical information or as indicated by Campbell and Stanly (1963) a quasi-experimental design based on time-series experiment. The research design was in line with the research questions that were tested to examine the significance of the independent variables to accurately predict the dependent variable or specifically the returns or security or portfolio of securities. I tested not only each independent variable to determine the significance to the dependent variable but also to other variables in the model and finally the model consisting of all independent variables. Since the data used in the study was quantitative and based on readily published historical data, there was limited intervention on the factors or variables used in the model other than the sorting procedure and conditional ranking as used in past studies like Mishra (2013). In addition, I grouped the securities by midsize stocks and was included in the portfolios of securities when the multiple regression analysis was performed. I tested the two-factor model in research question two and three and included the market premium and market capitalization or size to determine if a two-factor model was a viable means of determining returns or value of a security.

Methodology

The methodology that I used in this study was quantitative because of the objective measures for the independent and dependent variables that were used in factor models. I used statistical analysis and specifically regression analysis and determined the significance of the valuation models in determining the future value of a security or portfolio of securities. In particular, I tested and assessed the accuracy of valuation models and used selected samples of stocks that traded on established financial markets to ensure the results were an objective measure. However, there has been a debate in the literature as to population whether it was the observation of prices over a time period and as indicated by Fama and French (1993) as the population of the simulations or more precisely observations of stock prices and in their original study, it was between 1963 and 1991. In the study by Camara, Chun, and Wang (2009), they referred to this as the sample period. Other researchers like Alves (2013) assessed valuation models based on sampling individual securities trading on various international markets but did not state explicitly the sample strategies used in the study other than the requirements of the models and why certain securities were omitted. Camara, Chun, and Wang (2009) also did not explicitly state the sampling strategy or design, since they utilized stock indices as representative of the sample to the population like the S&P 100 index. The population of financial securities that the sample was selected was derived from the NASDAQ. There was $267 billion in U.S. equities traded electronically on the NASDAQ in 2013, and there were over 3,000 companies listed on the exchange (NASDAQ, 2013).

Sampling and Sampling Procedures

The population in this study were all the securities traded on the U.S. exchanges and were relatively small in comparison to other quantitative studies especially in the social sciences field. The sample size was based on the requirements of the FF model and the size factor and consisted of individual stocks and portfolios of stocks based on market capitalization. For comparative purposes, the Carhart four factor model (Carhart, 1997) was reviewed to understand other factors like momentum but was not tested. In this study, I utilized a time-series regression model and the sample consisted of time-series data with each observation of a variable at time *t* and assumption of randomness. The time-series regression model, the FF model, included random variables and were market premium, market capitalization, the book-to-market ratio of a financial security. There was a case to employ random sampling from the population of securities for the purpose of this study and was relatively small based on the number of stocks traded on U.S. financial markets. Probability sampling using stratification could have been more relevant if examining securities trading on different markets then this would have been the preferred sampling strategy. A possible limitation in the sampling or errors from the sample framing or clusters of elements only including certain types of securities based on specific criteria using stratification (Frankfort-Nachmias, & Nachmias, 2008). The actual size of samples I selected utilized the three factors or predictors in the Fama-French three factor model and the four factors in the Cahart model (Carhart, 1997) and the updated Fama-French five factor model (Fama & French, 2014) that were traded on the NASDAQ. I determined the population for the study based on observations of security prices for the period determined by the sample size beginning of the time period examined and consisted of the daily trading days based on a 52 week with 5 trading days.

Power Analysis using G*Power

The sample size was determined by G*Power, and the input parameters were statistical power, alpha, and effective size (Erdfelder, Buchner, Faul, & Lang, 2007). The statistical analysis used in the research was a linear multiple regression analysis that included statistical tests like the *F*-ratio, *t*-tests on the coefficients, and adjusted R^2. The input parameters used in the G*Power statistical analysis power program that I used was a low effect size of .02, low alpha size of .01, and a high power of .95. These three components, along with the sample, were interrelated and with the known three inputted parameters allowed for the determination of the sample size of the observations required for the research as noted by Trochim (2006). The statistical tests used a low alpha because it would provide a more rigorous test and that there would be a less chance of a Type I Error or rejecting the null hypothesis when it was true. The effect size used was small and in order to reduce the salience of the treatment relative to the noise in the measurement and the final component assumed a high power to increase the chance of observing a treatment effect when it occurs and in particular predicting the value of a security. The sample size was determined with input parameters in G*Power for three, four, and five predictors and provided sample size respectively of 1,140, 1,224, and 1,296. Since I tested all three models, the largest sample of 1,296 was used and based on a 52 week with 5 trading days or 260 observations then the data collected was over a 5-year period and was the minimum length for a subperiod. This was a limitation because of the financial crisis that arose in 2008 and skewed the results for the period between 2006 and 2010.

There were many more factors included in current valuation models, and as indicated by Hsu (2014) there was a *factor zoo* in current models with over 80 factors and some with over 600 factors. The results of G*Power for sample sizes for 80 and 600 factors were respectively 3,276 (12.6 years) and 7,954 (30.6 years). Fama and French (2014) looked at observations over a period 1963 to 2013 and augmented the original study by 21 years with the original being 1963 to 1993. Another study by Mishra (2013) of the Indian stock market included observations over an eight-year period for the years 1999 to 2007. Mishra's study was based on an examination of the FF model, and another study by Sehgal and Balakrishnan (2013) included observations from January 1996 to December 2010 or 15 years. Trimech and Kortas, (2009) used data for the Carhart four factor model for the French stock market from January 1995 to October 2006, or 11 years.

G*Power provided sample sizes, and the lowest number of observations was used as a baseline for the dataset for this study. The actual sample size of the observations was based on past studies; in order to ensure consistency, I used a minimum of 10 years of observations which were at the lower end of the spectrum of current studies but higher than the 5 years required based on G*Power.

Scaling and Data Measurement

The proper use of data measurement techniques in a quantitative research study was essential to identify and measure relationships of the variables to the research problem. Two data technique methods that were discussed by Frankfort-Nachmias and Nachmias (2008) was index construction and scaling, and was used as a reference for the study. In the social sciences, Frankfort-Nachmias and Nachmias also noted that the measurement of complex concepts was inherent to the human condition by the assignment of symbols or numbers to variables like power, bureaucracy, gender, and intelligence. They also referred to the variables in a quantitative study in the social sciences as items and for index construction which allowed two or more items to be combined to create an index. To use an index, a researcher must know what they were attempting to measure and how they will use the measure. This required looking at the sources of data and making a comparison on the basis of measurement. For scaling, this requires examining observations or responses and assigning a measurement scale like a Likert scale (Frankfort-Nachmias & Nachmias (2008). The first step in this process was to compile items under investigation and assign expressions based on a scale and should be from a range of three to not more than seven. The items were then assigned numerical values which then can be used to tally a total score. There were other scales, such as the Guttman Scaling, and tests for unidimensionality of a set of items or that all the items in a scale were on a continuum that can only apply to one concept.

Test and Scales used Valuation Models of Assets

The data measurement techniques I used to test the proposed research questions consisted of using index construction. This was due to the nature of the finance field and the nature of the variables used in the valuation models to determine the price of the financial security. The main variable that was used in the Fama-French (FF) three factor model was beta and required an index construction involving the variables for the security and market returns (Câmara, Chung, & Wang, 2009). I calculated beta by taking the covariance of the security return to market returns or the slope of the Security Market Line (SML). The other variables that were to be included were the risk-free rate which was to be constant and market returns, and were determined using indices and did not need to be constructed. The specific indices that I used were the Russell 2000 index (small caps), Russell Midcap index, Russell 200 index (big caps) and the Russell 3000 index for the whole market. The population size of the variables used in the calculation of beta determined the reliability and the validity of the estimate and was based on a short time-series of annual data (Nekrasov, & Shroff, 2009). Computation of beta became more complicated in the FF model since there were two other factors, market capitalization and value, and each had their own respective betas in the model. The instrument I used was the survey of stocks of different sizes based on market capitalization and book values. The other factors that scaling was used for size and value and for size it was small and big market caps, and for B/M it was based on high and low B/M, and in some studies, medium B/M was used.

Instrumentation and Operationalization of Constructs

The instrument I used in my research was a survey of financial securities that meet the requirements of the models. This was to ensure the results were valid and reliable since different models were compared. Also, I had to be careful in the examination of the instrument that was used based on the three-time periods that beta and other coefficients were calculated since it was recommended that this be a limited period otherwise it would become less reliable as a factor in predicting future prices. There was another concern of the period that the survey could take place since market anomalies or systemic factors that affected markets did not affect the results when using these models for future predictions like the financial crisis of 2008.

Archival Data

I collected historical archival data from publicly available data and were based on past research instrumentation to provide validity of the results. The cost to obtain raw and real-time data were cost prohibitive, and only publicly available data were used. I did not require permission for access to the data. The main data sources were from the Kenneth R. French data library and the Russell indices and were unquestionably a reputable source since he had authored the seminal works on current valuation models in the academic literature. Similarly, I collected historical data from the Russell indices that included the Russell 2000 index (small caps), Russell Midcap index, Russell 200 index (big caps) and the Russell 3000 index for the whole market

Data Analysis Plan

The main data analyses plan I used was based on the current works on valuation models and applied them to the current study. Many of the current studies were from international researchers that had applied the current valuation models and applied them to different economies globally. The data that were analyzed and examples were works by Artmann, et al. (2012) for the German market, Chun-An, et al. (2012) for the Taiwan market, Fajardo, and Fialho, (2010) for the Brazilian market, Olbrys, (2011) for the Polish market, and Trimech, and Kortas, (2009) for the French market. Finally, the main area of the study examined the size factor in the valuation of financial assets and in particular publicly traded firms that traded on recognized exchanges. The size factor was examined on how to sort firms by small and large sized firms, changes over time, correlation to other factors, and the effects of financial shocks to firms based on size, and was the focus of this study.

Multiple regression analysis was the statistical test that I used to test the hypotheses. The software I used in the study was the Statistical Package for the Social Sciences (SPSS) statistical software package and also Excel spreadsheets with an add-on to do multiple regression and to collect and clean data that were collected. The main sources of data that I collected were from secondary databases and were derived from the Kenneth R. French data library (French, 2017) and the Russell indices that were continuously updated and was used by current academics. My research did not examine covariates or control variables since in the current literature there could be litany of variables or factors that could be used and was described as a *factor zoo* (Hsu, 2014). The testing I performed also included procedures to examine confounding variables or if one of the variables was an extraneous variable in the model that correlates (directly or inversely) with another independent variable. For the FF model, this meant one of the three variables was correlated with another variable. The statistical test used was the F-ratio or the F-distribution under the null hypothesis. The F-ratio was consistent with the current analysis of valuation models in the current literature and identified if the model fits best with the population of the data sample.

The first research question, I focused on the FF model and its ability to predict future market values of individual stocks. The market capitalization variable was used on different sized stocks that included mid-caps and not only small and big caps and determined the significance of model based on the statistical results. The FF model was tested to compare with the results of the two-factor model and when only small and big sized caps stocks were used. The second question used portfolios instead of individual stocks to determine if the size as measured by market capitalization affected the accuracy of financial returns that used the FF model modified only with two-factors or market premium and the size factor. Again, mid-caps were included and compared to results if mid-cap sized where used through a hierarchical regression. The third research question examined the effects to the dependent variable of returns by repeating tests of the current models and analyzed with each variable grouped in pairs in the model to assess the effectiveness of the measure and to ensure the internal reliability of the hypothesis of research questions one and two. The pair groupings I utilized was the two-factors of market capitalization and book-to-market (B/M) and were respectively small, midsize, and large caps and low, medium, and high B/M. I represented the different size sorts by nine groupings of market capitalization and B/M or small/low (SL), small/medium (SM), small/high (SH), midsize/low (MDL), midsize/medium (MDM), midsize/high (MDH), big/low (BL), big/medium (BM), and big/high (BH). I designed the groupings to include mid-cap firms. In past studies, researchers used only six groupings based on small and big caps and a sorting of 2x3 (size by B/M) that was expanded in my investigation by the inclusion of midsize cap firms (3x3 sort) and was the focus of the last research question. Again, I compared the results if the normal methodologies were applied that did not include mid-caps in the groupings for both market capitalization and B/M factors.

1. RQ 1: What are the differences, if any, between using different sized stocks (small, mid-cap, or big) in the accuracy of predicting financial returns informed by the FF model?

   $H_0$1: Market capitalization as a proxy for size is not a significant predictor of future returns of a stock using the FF model.

   H_a1: Market capitalization as a proxy for size is a significant predictor of future returns of a stock using the FF model.

   The independent variable is the size factor, and the dependent variable is stock's return.

2. RQ 2**:** What are the differences, if any, between using different sized portfolios (small, mid-cap, and big) in the accuracy of predicting financial returns informed by the modified FF model with only two-factors that included mid-caps?

   $H_0$2: Market capitalization as a proxy for size is not a significant predictor of future returns of a portfolio using the modified FF model.

   H_a*2*: Market capitalization as a proxy for size is a significant predictor of future returns of a portfolio using the modified FF model.

   The independent variable is the size factor and the dependent variable is the portfolio's return.

3. RQ 3: What are the differences, if any, between using nine groupings of portfolios based on size and B/M in the accuracy of predicting financial returns informed by the modified FF model with only two-factors that included mid-caps?

   $H_0 3$: Grouping based on both market cap and B/M is not a significant predictor of future returns of a portfolio using the modified FF model.

   $H_a 3$: Grouping based on both market cap and B/M is a significant predictor of future returns of a portfolio using the modified FF model.

   The independent variables are the size and B/M, and the dependent variable is the portfolio's return.

Threats to Validity

Threats to validity could be either internal or external based on inferences or causal relationships identified or measured. As indicated by Creswell (2013), internal validity threats could occur from the research process, treatments used in the study, and independent variables that were manipulated and for my study, it was for the factors in the valuation models. The process must be based on established assessments of valuation models or past methodologies used in collecting and manipulating financial data to test current valuation models.

Internal Validity

To establish internal validity for the treatment, I used the appropriate risk-free rate and the calculation of beta must be appropriate for the same time period for the data collected as with the study by Alves (2013). Manipulation of independent variables needed to be performed and was based on past studies to limit the threat of internal validity of the findings. To accomplish the proper manipulation of the variable, I used the required setting procedures of sorting and ranking (2x3 and 3x3 sorts) of data and used the size and B/M or small, mid, and big size and low, medium, and high for B/M. For the market capitalization factor or variable, the sorting process required methodologies of classifying stocks on the basis of the market cap of small, mid-cap, and big. The main threat to validity was when individual stocks changed in size or market capitalization during the period of investigation. In one period, a stock could be classified as a small sized stock, but in the next period, it was a midsized or big sized stock or the opposite. The size classification change was a threat and was also applicable to the other variables like book-to-market where a firm's ratio of its stated book or market value changed over the period from low, medium, and high. To ensure this internal threat to validity, I used the data collected from Kenneth R. French dataset (French, 2017) and the Russell indices which were re-assessed or reconstituted the independent variables over the time period provided in their historical dataset.

The capital structure of a firm could also affect validity based on Modigliani-Miller theorem (Modigliani & Miller, 1958) which stated capital structure should not be a factor. I did not include this as an assumption based on the samples selected for testing since capital structure could affect value. Based on the nature of the valuation of the models, I assumed that the capital structure could affect the independent variable or factor of the book-to-market variable. The book value of a firm was based on the capital structure of a firm and was calculated from the balance sheet of a firm or accounting information where the book value was determined by total assets minus total liabilities. The calculation could be problematic, that in order to capitalize or to ensure a firm has the assets to meet its liabilities it must issue debt or equity and the more debt issued, the firm risk as it related to the cost of capital rises, could affect the ability to raise future capital and thus affect value of the firm.

External Threats

The external threats to validity were the systematic market anomalies like the crisis of 2008 or volatility that could not be firm or industry specific. With the recent advent of globalization, international factors like currency exchange risk and geopolitical events could be an external threat and I accounted for this threat by three periods to be tested to establish external validity. If efficiency of markets or EMH held true for the strong form then investors could not be able to obtain excess returns and would provide no incentives to buy and sell securities through financial markets but from past studies this form of efficiency had not been evident and was based on the large volumes of trades in the major markets (Berk & DeMarzo, 2014). The main threat to validity I reviewed was market volatility and was in the past been a concern like with the recent financial crisis and asset bubbles that can seriously skew or under/overstate findings or relationships of the variables. Some volatility would be expected as a natural aspect of financial markets and was described by the current literature as the random behavior of stock price movements where stock prices should not be predictable and appear to move randomly (Mishra, 2013). During the financial crisis, not all industry sectors were affected as noted by Sanusi and Ahmad (2016) in their study were oil and gas companies' stock returns were not affected unlike 2014 and 2015 with the extreme drop of oil prices but overall it did not affect many other sectors. Theoretically, volatility and crisis of 2008 could be a threat since valuation models should not be effective in predicting future market prices based on historical information, but this was the same issue with all past studies of valuation models.

Construct Validity

The potential design and/or methodological weaknesses of my research could be broken down by the firm, industry, and market risks. Firm specific risks and those aspects faced by businesses that could affect the results and I avoided these types of risks by the selection of fifteen firms for the sample data to provide rigor for the testing to compare when portfolios were tested. life cycle of a firm (Hanks, 2015) was another complication when firms go through growth and mature phases, and the fifteen firms that were chosen were classified by their market capitalization and should resolve business cycle issues based on their size relative to other firms listed on public exchanges. Limitations of industry risks or other idiosyncratic risks could be a greater weakness to overcome but was addressed by using different time periods to establish validity. Market risks and volatility based on systemic issues with the economy or global and geopolitical events required a separate analysis to see how the models would fair under extreme conditions and a period of the financial crisis of 2008 was tested for the period between

2006 to 2010. Since the data were readily available, the models were tested for a sample set before, during, and after the financial crisis of 2008. The extra testing required me to do extra work but provided guidance as to the effects of value under extreme conditions and to determine the extent of the threat to validity in comparison to normal market conditions.

Ethical Procedures

The ethical procedures that I used in the study for the data collection process were not extensive. Data collected for the study was readily available and did not infringe on any copyrighted material. The cost of collecting original source data would be cost prohibitive if the same data collection process were used as other academic and investment institutions. Since costs to obtain raw data were cost prohibitive, I used publicly available data. Since I used no human participants in the study, the IRB application process was straightforward and completed and reviewed to ensure all requirements were met. Confidentiality was not a concern since the data collected were publicly available and dissemination, accessibility, and destruction of data were not an ethical concern. Storage of data was addressed by backing up of data on multiple platforms.

Summary

The empirical nature of the variables used in current valuation models and the data that were analyzed required a research design that addressed the limitations of current valuation to determine value using a stand-alone two-factor model and mid-caps in current models. The historical data that I collected was based on a quasi-experimental design. The population of data that I collected was from the main U.S. stock exchanges. The methodologies I used were based on current research that was done internationally and not only on U.S. financial markets. All processes, designs, and methodologies I used were based on the current gap in the literature were only small and big sized stocks were used to include mid-cap stocks. As a result, I was able to connect the methodologies with the research questions where the focus was to test a two-factor model that included mid-caps to produce better models. Consequently, the tests of a new two-factor model that included mid-cap stocks required to use sorting and conditional ranking to connect the main gaps in the current literature and was the focus of the research questions. Threats to validity included internal threats of manipulation of the independent variables and specifically of market cap that required methodologies to include mid-cap sized stocks. Another internal threat was the capital structure of firms, and I assumed that the Modigliani-Miller theorem did not hold true and that the capital structure did affect value. External threats included systematic challenges of financial crisis and globalization and was an opportunity to test the robustness and rigor of current and proposed models. The construct validity methodologies used was to account for the firm, industry, and market risks and was addressed by using the methodologies currently used in current research studies. Ethical considerations were minimal since this study does not use human participants and the data that were collected and analyzed was publicly available.

In chapter four, I documented the results of the testing of the research questions of the study. I reviewed the data collection process and analysis of the tests performed on the valuation models. In addition, I reviewed the treatment of the variables, and in particular, the factors of the models were discussed and if there was any intervention in the process to ensure the validity of results. The final study results were presented and concluded with the connection to the research questions and conclusions and as to the rigor and reliability of current valuation models and the proposed change of a two-factor model that included mid-cap sized stocks.

Chapter 4: Results

The purpose of this study was to explore and better understand the size factor in the FF model to produce a better valuation model. The first research question examined the current FF model's ability to determine the value of individual stocks based on market capitalization. I tested the null hypothesis if market capitalization as a proxy for size was not a significant predictor of future returns of a stock using the FF model. The second research question examined if there were any differences that used different sized portfolios (small, mid-cap, and big) in the accuracy of predicting financial returns informed by a modified FF model or a two-factor model that included mid-caps. The null hypothesis that I tested was if market capitalization as a proxy for size was not a significant predictor of future returns of a portfolio using the modified FF model. The final research question addressed whether or not there were differences between using nine groupings of portfolios based on size and B/M in the accuracy of predicting financial returns informed by the modified FF model with two-factors that included mid-caps. The null hypothesis that I tested portfolios grouped based on both market cap and B/M was not a significant predictor of future returns of a portfolio using the modified FF model.

In the next section, I review the data collection that was used followed by the statistical analysis and assumptions that were used for the testing of the models. The study results were presented for each research question and included were additional results for the revised two-factor model. The final section I examined was the validity of the multiple regression assumptions and followed with a summary of the chapter.

Data Collection

The timeframe from that I collected the data covered a 10-year period from 2006 to 2015. External validity for this period was a concern since the market anomaly of the financial crisis of 2008 occurred during the period of data collection and could skew the results of the regression analysis. To account for the market crash of 2008, I isolated the period of data collection using the volatility index or VIX. The breakpoint between the two periods I determined was based on the average daily volatility index or VIX. The VIX between the entire period of 2006 and 2015 was 20.42. The breakpoint for the when the financial crisis of 2008 occurred, 2006 to 2010, the VIX was 23.46 or greater than the entire period. The next period, 2011 to 2015 was less than the average for the entire period or the period of the financial crisis of 2008 and was 17.41 (Volatility Index (VIX), 2017). From the analysis performed using the VIX, I divided the ten-year period from 2006 to 2015 into three periods. The main period for analysis was for the full 10-years and two 5-year periods from 2006 to 2010 and 2011 to 2015.

The data collected for the first research question were from the Kenneth R. French data library (French, 2017). The data included returns of the factors in the FF model and were the returns for the risk-free rate, market premium factor (market minus risk-free rate), size factor (SMB), and value factor (HML). The risk-free rate was based on the 1-month T-bill rate to determine the daily rate. I constructed the factors using six value-weight portfolios formed on size and book-to-market to derive the daily returns and was collected from Center for Research Security Price Prices (CRSP) for U.S. stocks listed on the NYSE, AMEX, or NASDAQ (CRSP, 2017). For the dependent variable, I randomly selected individual stocks based on size or market capitalization and the returns of the stocks were collected from Yahoo Finance (Yahoo, 2017) and Google Finance (Google, 2017). The first research question tested the FF model's accuracy to predict financial returns of randomly selected stocks based on size (small, mid-cap, and big). The null hypothesis that the FF model was not a significant predictor of future returns of individual stocks based on size, was tested with multiple regression analysis.

For the second research question, the data I used to construct the two-factor model were collected from the Kenneth R. French data library (French, 2017) and the Russell Indices FTSE Russell, (2017). The two-factor model included a new market premium factor and was the Russell 3000 index and a size factor that included mid-caps or the SMMDMB factor. I tested the two-factor, and as a validity check and comparison purposes, I also tested the FF model. The risk-free rate that was used for both models was from the Kenneth R. French data library (French, 2017) to ensure the results did not create internal validity concerns when comparing the two models. The dependent variable data that I collected were for three portfolios of stocks based on market capitalization of small, mid-cap, and large size stocks. The three portfolios selected were the Russell 2000, Russell Midcap, and the Russell Top 50 Mega indexes. The research question that I tested was whether the two-factor model's accuracy to predict financial returns of the three portfolios based on size (small, mid-cap, and big). The null hypothesis for the two-factor model that was tested if was not a significant predictor of future returns of portfolios based on size and the model was tested with multiple regression analysis.

The third research question I examined was the two-factor model, and the sample of nine portfolios was tested. The nine portfolios that I used were the Russell indexes and the size factor was constructed based on size and B/M to mimic the sorting methodologies that were used when researchers or investors use the data provided by Kenneth R. French database or creating their own portfolios. The specific research question that I tested was whether the two-factor model's ability to predict financial returns of nine groupings of portfolios based on size and B/M and the FF model was used for comparison or as a benchmark to make this determination. The null hypothesis that I tested was if the two-factor model was not a significant predictor of future returns of a portfolio based on size and B/M, was tested with multiple regression analysis.

Other or additional tests I performed for research question three were based on nonconclusive results from the original tests. All the research questions I examined with statistical tests that produced outputs such as descriptive statistics, model summary, Durbin-Watson statistic, ANOVA, coefficients, collinearity diagnostics and casewise diagnostics.

Statistical Analysis and Assumptions

The statistical analysis that I performed using SSPS were descriptive statistics, model summary, ANOVA, coefficients, collinearity diagnostics and casewise diagnostics. The descriptive statistic provides comparisons of the means of the different variables in the models under study. The model summary provided the *R*, R^2, and adjusted R^2 which was very important to determine the fit of the variables or factors to the model. The adjusted R^2 statistic provided the variance of each factor to the variance of the dependent variable or the excess returns. Kan and Gong (2016) referred to the extent of the co-movement between the variables in the model as the stock return synchronicity. The adjusted R^2 statistic was also used to compare different models for the tests between the two-factor model and the FF model as with past study by Jiao and Lilti (2017) where they compared the FF three factor model with the FF five factor model and used the adjusted R^2 in their analysis. The model summary also provided the Dustin-Watson statistics and tested for autocorrelation or nonrandomness that can arise through independent errors, which was referred to as *white noise* by Vermeulen (2016). I set the Durbin-Watson statistic to the statistical parameters of 2 and if there were problems in the model the statistic would be less than 1 or greater than 3 and the closer the measure was to 2 would be an indication of a good model as indicated by Field (2013).

The ANOVA analysis provided on how valid or significant was the regression model and as indicated by Field (2013), that if the model was not significant than it would be better to use the means to predict the outcomes than the model. The output provided the *b*-values, *t*-tests and the *F*-ratio statistic. The *b*-values where the relationship between the predictor (factor) and the outcome and for this case the excess returns of the individual stock and if the *t*-test where $p > .001$, then the *b*-value was not significant and does not affect the dependent variable or outcome. The *F*-ratio indicated if the model was a significant fit of the data improved the predictability of the outcome and was determined if $P < .001$. Also, a concern was if *b*-values were 0, and would mean the independent variable or factor did not affect the dependent variable and the null hypothesis cannot be rejected.

Tests were performed to determine collinearity (between two independent variables) and multicollinearity (two or more independent variables) or where there was a very high correlation between independent variables or factors. Collinearity (for two-factor models) and multicollinearity (three factor models) was determined through the correlation matrix with high correlations or where $r > .9$. Another statistical test I used for collinearity was the variance inflation factor (VIF) statistic where Field (2013) noted that if VIF statistic was below .2 and greater than 10 there was a concern or problem with collinearity or multicollinearity. If the VIF statistic result was 1 then this would indicate no collinearity and if greater than 1 and less than 10 then there could be bias between the variables.

The casewise diagnostics provided an indication if there were extreme outliers that could affect the models to predict the dependent variable or the returns of the samples that were tested because of errors in the data. I used a casewise diagnostic measure of 2 standard deviations from the mean to be conservative. If greater than 2 standard deviations from the mean would indicate extreme outliers and based on 5% of the data collected for the three-time periods of 2015 – 2006, 2015 – 2011, and 2010 –

2006, there were 2,517, 1,258, and 1,259 cases respectively and the acceptable cases would be 126, 63, and 63 respectively or 5% of the sample cases.

The statistical assumptions I used for the multiple regression analysis were based on the variables in the model. The first assumption I made was that the predictor variables (factors) and outcome variables outcome variable (excess returns of a security or portfolio of securities) must be quantitative, continuous, and unbounded. For the dataset used in the analysis, the assumption held true and was not violated since they were the daily returns of a stock, portfolio of securities, and the risk-free rate. There should be no nonvariance values for the predictor variables; this was true of this analysis based on the daily returns of stocks or portfolio of securities. A perfect multicollinearity or where there was a perfect relationship between the predictor variables would indicate problems with the models and this can be determined from the collinearity diagnostics. I assumed throughout the tests that the FF model was a benchmark and used for comparison to the two-factor model. This was based on the past and the current academic literature since 1993, where the FF model has been the focus of research, most noticeably in international financial markets and the development of new multifactor models.

Study Results

I performed multiple regression analysis with SSPS statistical software to test the multifactor models for the FF model and the two-factor. The statistical outputs from the tests included descriptive statistics, model summary, ANOVA, coefficients, collinearity diagnostics and casewise diagnostics for the three research questions. I used hierarchical regression to assess the individual factors in the model over three-time periods. I performed additional tests for the third research question based on the results of the first test and a revised two-factor model was tested for the sample data of 9 portfolios and 15 individual stocks.

Research Question #1: FF Model and Individual Stocks

The FF model included three factors and the risk-free rate as described in regression equation 1 where the dependent variable was the returns of a security or portfolio of securities. To perform the multiple regression analysis, regression equation 1 was revised to determine the excess returns or the returns in excess of the risk-free rate in order to perform the testing in line with how models were tested in past research. The data for the returns for the individual stocks were adjusted by subtracting the returns with the risk-free rate and the new regression equation was presented in regression equation 12.

Fama-French Three Factor Model (Fama & French, 1993) – Regression equation 12

$$Rit - Rft = \beta i(Rmt - Rft) + siSMBt + hiHMLt + \varepsilon it \quad (12)$$

Hierarchical regression was used to better determine the contributions of the size factor and statistical control for the factors in the FF model. The sequential order that the factors were inputted into the model began with the size factor (SMB), value factor (HML), and then the premium factor (MRK_RF). The output results of the statistical analysis that was performed were descriptive statistics, model summary, ANOVA, coefficients, collinearity diagnostics and casewise diagnostics.

Sample Selection

The individual stocks that I selected to test the FF model in the first research question were randomly chosen from publicly available information. I selected a total of 15 stocks to be tested in the current FF model that included five large caps, five mid-caps, and five small caps. The sample selection criteria were based on the ability of any individual investor to be able to pick a stock using publicly available information, and for these samples they were picked using the listing of stocks provided by iShares Russell Top 200 ETF for large caps (IWL), iShares Russell Mid-Cap ETF for mid-caps (IWR), and iShares Russell 2000 ETF(IWM) for small caps (iShares, 2017).

I picked the individual stocks for the sample to be tested based on size classification of small, mid, or large and were actively traded during the period of the study. To meet the size requirement, five stocks were randomly selected from each ETF from the listing on the dates of December 31, 2015 and cross-checked if the stock was listed on December 31, 2010, and December 31, 2006. Consequently, information was not available for iShares Russell Top 200 ETF for large caps (IWL) for December 31, 2006, therefore, iShares Russell 3000 ETF (IWV) was used to cross-check if the individual stock was listed in the top 200 stocks based on market capitalization. Individual stocks were selected by assigning a number for each stock listed on the ETF, and a random generator was used in excel to pick the corresponding stock with the number that was assigned. The stock selected was cross-checked to make sure that it was listed and had the same market capitalization for each of the three time periods of the study. A total of 28 stocks were picked to derive the 15 stocks that were analyzed and were listed in Table 5 and Table 6 list the stocks that did not meet the requirements of listing during the entire period in the same size category (small, mid, or large caps).

Table 5

Selected Individual Stocks

Stock	Ticker	Exchange	Data Source
Large Capitalization			
3M Company	MMM	NYSE	Yahoo Finance
Allstate Corporation	ALL	NYSE	Yahoo Finance
Prudential Financial, Inc.	PRU	NYSE	Yahoo Finance
IBM	IBM	NYSE	Yahoo Finance
Occidental Petroleum Corp.	OXY	NYSE	Yahoo Finance
Medium Capitalization			
IAC Interactive	IACI	NASDAQ	Yahoo Finance
NetApp, Inc.	NTAP	NASDAQ	Yahoo Finance
Intercontinental Exchange Inc.	ICE	NYSE	Yahoo Finance
Cablevision Systems Corp.	CVC	NYSE	Google Finance
Masco Corp.	MAS	NYSE	Yahoo Finance
Small Capitalization			
National Penn Bancshares, Inc.	NPBC	NASDAQ	Google Finance
Crawford & Company	CRD.B	NYSE	Google Finance
Snyder's-Lance, Inc.	LNCE	NASDAQ	Yahoo Finance
Gorman-Rupp Company	GRC	NYSE Mkt Llc	Yahoo Finance
Universal Technical Institute, Inc.	UTI	NYSE	Google Finance

Table 6

Stocks Not Listed by Size Category in the Time Periods Tested

Stock	Ticker	Size	December 31, 2010	December 31, 2006
Express Scripts Holding Co.	ESRX	Large	Listed	Not Listed
Lyondellbasell Industries	LYB	Large	Not Listed	Not Listed
Proassurance Corp.	PRA	Mid	Not Listed	Not Listed
Cinemark Holdings Inc.	CNK	Mid	Listed	Not Listed
Aegerion Phamaceuticals Inc.	AEGR	Small	Not Listed	Not Listed
Otonomy Inc.	OTIC	Small	Not Listed	Not Listed
Urban Edge Properties	UE	Small	Not Listed	Not Listed
Tokai Pharmaceuticals Inc.	TKAI	Small	Not Listed	Not Listed
PDC Energy Inc.	PDCE	Small	Not Listed	Not Listed
Sunrun Inc.	RUN	Small	Not Listed	Not Listed
Washington Federal Inc.	WAFD	Small	Not Listed	Not Listed
Nevro Corp.	NVRO	Small	Not Listed	Not Listed
Black Diamond Inc.	BDE	Small	Not Listed	Not Listed

Statistical Results

I provided the descriptive analysis for the individual stocks by size categories for the three-time periods were listed in Table 8, Table 9, and Table 10. The average or mean daily returns of the individual stocks varied and were firm specific. The average or mean daily returns of the factors for the three periods were listed in Table 7 and indicated that the size and value factor average returns for the period were quite different from the market premium returns except for the 2010 – 2006 period where the SMB factor daily mean return of 0.00014 and was close to the market premium of .00015. Over this period, the HML daily mean return was almost 0. For the period between 2015 - 2011, both SMB and HML had negative returns whereas the market premium was positive and for the entire period the three returns were quite different.

Table 7

Descriptive Statistics - Factors

	2015 - 2006			2015 - 2011			2010 - 2006		
Stock	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
SMB	0.00004	0.00593	2,517	-0.00007	0.00517	1,258	0.00014	0.00661	1,259
HML	-0.00004	0.00692	2,517	-0.00008	0.00436	1,258	0.00000	0.00876	1,259
MRK_RF	0.00033	0.01310	2,517	0.00050	0.01002	1,258	0.00015	0.01558	1,259

Table 8

Descriptive Statistics - Large Capitalized Sized Stocks

	2015 - 2006			2015 - 2011			2010 - 2006		
Stock	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
3M Company	0.00032	0.01428	2,517	0.00051	0.01179	1,258	0.00013	0.01639	1,259
Allstate Corporation	0.00026	0.02216	2,517	0.00061	0.01293	1,258	-0.00010	0.02855	1,259
Prudential Financial, Inc.	0.00058	0.03418	2,517	0.00043	0.01859	1,258	0.00072	0.04463	1,259
IBM	0.00026	0.01392	2,517	0.00002	0.01215	1,258	0.00049	0.01549	1,259
Occidental Petroleum Corp.	0.00024	0.02544	2,517	-0.00015	0.01716	1,258	0.00063	0.03162	1,259

Table 9

Descriptive Statistics - Medium Capitalized Sized Stocks

	2015 - 2006			2015 - 2011			2010 - 2006		
Stock	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
IAC Interactive	0.00041	0.01790	2,517	0.00073	0.01702	1,258	0.00010	0.01874	1,259
NetApp, Inc.	0.00025	0.02443	2,517	-0.00039	0.01926	1,258	0.00089	0.02867	1,259
Intercontinental Exchange Inc.	0.00120	0.03090	2,517	0.00072	0.01486	1,258	0.00169	0.04109	1,259
Cablevision Systems Corp.	0.00041	0.02562	2,517	0.00021	0.02256	1,258	0.00061	0.02836	1,259
Masco Corp.	0.00031	0.02762	2,517	0.00090	0.02288	1,258	-0.00028	0.03166	1,259

Table 10

Descriptive Statistics - Small Capitalized Sized Stocks

	2015 - 2006			2015 - 2011			2010 - 2006		
Stock	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
National Penn Bancshares, Inc.	0.00023	0.02921	2,517	0.00051	0.01829	1,258	-0.00005	0.03704	1,259
Crawford & Company	0.00081	0.04227	2,517	0.00091	0.03342	1,258	0.00071	0.04958	1,259
Snyder's-Lance, Inc.	0.00041	0.02073	2,517	0.00043	0.01605	1,258	0.00039	0.02453	1,259
Gorman-Rupp Company	0.00054	0.03170	2,517	0.00019	0.02574	1,258	0.00089	0.03671	1,259
Universal Technical Institute, Inc.	-0.00035	0.02928	2,517	-0.00083	0.02775	1,258	0.00013	0.03073	1,259

I provided the complete model summary SSPS output in Appendix A and in Table 11 was the summary results for each of the models. A hierarchy was used for the predictor variables (factors) for analysis beginning with the SMB and followed with the HML and market premium factors. The hierarchy was used to determine how the size factor would perform independently or isolated from the other two factors. The adjusted R^2 accounts for the variance in excess returns of the stock or the dependent variable, was very low for the size factor (SMB) of adjusted R^2 of 0 to a high of .250. At the most, the size factor accounted for 25% of the variance of excess returns and did not explain a large portion of the variance of excess returns. The adjusted R^2 was noticeably very low for all the periods for the large cap stocks and higher for low cap stocks. The HML factor, when added to the model, the adjusted R^2 improved the model but was very low with the lowest adjusted R^2 of .004 and when rounded would not account for even half a percent of the variation in the returns but the highest adjusted R^2 of .399 or explaining 39.9% of the variance of the dependent variable of excess returns of the individual stocks. In most of the analysis, the HML factor improved the model's explanations of excess returns except in four tests where it improved the model less than .001 in the adjusted R^2. As expected, the market premium factor, when added to the model greatly explained the variation of the excess returns of the individual stocks from a low adjusted R^2 of .063 or 6.5% to a high of an adjusted R^2 of .732 or explaining 73.2% of the variance of excess returns. The Durbin-Watson statistic average was 2.051, with a low of 1.804 and high of 2.497 and no indication of autocorrelation or non-randomness that can arise through independent errors.

Table 11

Model Summary - Adjusted R^2

Model Summary	2015 - 2006 Adjusted R^2	2015 - 2011 Adjusted R^2	2010 - 2006 Adjusted R^2
3M Company			
Model 1: (Constant), SMB	0.013	0.060	0.001
Model 2: (Constant), SMB, HML	0.109	0.085	0.136
Model 3: (Constant), SMB, HML, MRK_RF	0.603	0.661	0.579
Allstate Corporation			
Model 1: (Constant), SMB	0.001	0.037	-0.000
Model 2: (Constant), SMB, HML	0.270	0.155	0.312
Model 3: (Constant), SMB, HML, MRK_RF	0.585	0.568	0.592
Prudential Financial, Inc.			
Model 1: (Constant), SMB	-0.000	0.082	0.009
Model 2: (Constant), SMB, HML	0.336	0.219	0.398
Model 3: (Constant), SMB, HML, MRK_RF	0.640	0.732	0.634
IBM			
Model 1: (Constant), SMB	0.006	0.020	0.000
Model 2: (Constant), SMB, HML	0.054	0.021	0.088
Model 3: (Constant), SMB, HML, MRK_RF	0.512	0.430	0.567
Occidental Petroleum Corp.			
Model 1: (Constant), SMB	0.000	0.060	0.004
Model 2: (Constant), SMB, HML	0.053	0.132	0.052
Model 3: (Constant), SMB, HML, MRK_RF	0.465	0.548	0.463
IAC Interactive			
Model 1: (Constant), SMB	0.029	0.062	0.012
Model 2: (Constant), SMB, HML	0.063	0.062	0.097
Model 3: (Constant), SMB, HML, MRK_RF	0.291	0.279	0.313
NetApp, Inc.			
Model 1: (Constant), SMB	0.021	0.047	0.011
Model 2: (Constant), SMB, HML	0.057	0.048	0.069
Model 3: (Constant), SMB, HML, MRK_RF	0.387	0.308	0.428
Intercontinental Exchange Inc.			
Model 1: (Constant), SMB	0.003	0.037	-0.000
Model 2: (Constant), SMB, HML	0.090	0.053	0.106
Model 3: (Constant), SMB, HML, MRK_RF	0.385	0.397	0.403
Cablevision Systems Corp.			
Model 1: (Constant), SMB	0.007	0.028	0.000
Model 2: (Constant), SMB, HML	0.096	0.030	0.165
Model 3: (Constant), SMB, HML, MRK_RF	0.315	0.185	0.402
Masco Corp.			
Model 1: (Constant), SMB	0.054	0.099	0.034
Model 2: (Constant), SMB, HML	0.242	0.116	0.336
Model 3: (Constant), SMB, HML, MRK_RF	0.504	0.440	0.550

National Penn Bancshares, Inc.			
Model 1: (Constant), SMB	0.027	0.198	0.003
Model 2: (Constant), SMB, HML	0.039	0.362	0.004
Model 3: (Constant), SMB, HML, MRK_RF	0.063	0.633	0.005
Crawford & Company			
Model 1: (Constant), SMB	0.111	0.185	0.080
Model 2: (Constant), SMB, HML	0.162	0.211	0.143
Model 3: (Constant), SMB, HML, MRK_RF	0.318	0.349	0.306
Snyder's-Lance, Inc.			
Model 1: (Constant), SMB	0.105	0.127	0.095
Model 2: (Constant), SMB, HML	0.140	0.139	0.140
Model 3: (Constant), SMB, HML, MRK_RF	0.273	0.342	0.251
Gorman-Rupp Company			
Model 1: (Constant), SMB	0.117	0.250	0.065
Model 2: (Constant), SMB, HML	0.220	0.279	0.208
Model 3: (Constant), SMB, HML, MRK_RF	0.504	0.501	0.507
Universal Technical Institute, Inc.			
Model 1: (Constant), SMB	0.081	0.133	0.052
Model 2: (Constant), SMB, HML	0.124	0.156	0.110
Model 3: (Constant), SMB, HML, MRK_RF	0.210	0.221	0.208

An ANOVA analysis was performed to determine if the models tested was significantly better in predicting excess returns over than just using the mean. The *F*-ratio examined if the model improved the predictability of the outcome and the variance in excess returns of the stock was a significant fit to the data and the complete SSPS output was in Appendix B. Overall, most of the models were a significant fit except for specific stocks over specific periods for model 1 or with just the SMB factor. Only for National Penn Bancshares Inc. stock was the *F*-ratio not significant for all three models and with all the factors it was $F(3, 1255) = 2.955$, $P > .001$. The list of cases with the *F*-ratios that were non-significant were summarized in Table 12 and indicated the models that were not a significant fit but also had very low adjusted R^2 for these individual stocks. An important pattern for both the *F*- ratio and the adjusted R^2, was that none of the anomalies appeared for the period after the financial crisis of 2008 of the period from 2015 - 2011. Also, of the 15 cases for large capitalized stocks, 7 cases or 47% of the cases and of the 13 cases, 11 of the cases were for model 1 or when only the SMB factor was used in the testing based on the hierarchical regression used in the tests. This could be a concern in future testing but was not conclusive as to the viability of the size factor as a credible predictor variable. In total, there were 135 cases (15 stocks for three models over three periods) that were tested, and only 13 cases were of concern and indicated that the current FF model was a significant predictor of future returns majority of the cases but was not conclusive for the size factor when used independently.

Table 12

ANOVA (Non-significant) and Adjusted R²

Stock	Size	Period	Sum of Squares	df	Mean Square	F	Sig.	Adjusted R Square
3M Company Model	Large	2010 - 2006	0.001	1	0.001	2.505	.114[a]	0.001
Allstate Corporation	Large	2015 - 2006	0.001	1	0.001	2.460	.117[a]	0.001
Allstate Corporation	Large	2010 - 2006	0.001	1	0.001	0.748	.387[a]	- 0.000
Prudential Financial, Inc.	Large	2015 - 2006	0.000	1	0.000	0.051	.821[a]	- 0.000
IBM	Large	2010 - 2006	0.000	1	0.000	1.562	.212[a]	0.000
Occidental Petroleum Corp.	Large	2015 - 2006	0.001	1	0.001	1.294	.255[a]	0.000
Occidental Petroleum Corp.	Large	2010 - 2006	0.007	1	0.007	6.640	.010[a]	0.004
Intercontinental Exchange Inc.	Mid	2015 - 2006	0.009	1	0.009	9.450	.002[a]	0.003
Intercontinental Exchange Inc.	Mid	2010 - 2006	0.002	1	0.002	0.922	.337[a]	- 0.000
Cablevision Systems Corp.	Mid	2010 - 2006	0.001	1	0.001	1.599	.206[a]	0.000
National Penn Bancshares, Inc.	Small	2010 - 2006	0.007	1	0.007	4.932	.027[a]	0.003
National Penn Bancshares, Inc.	Small	2010 - 2006	0.009	2	0.005	3.346	.036[b]	0.004
National Penn Bancshares, Inc.	Small	2010 - 2006	0.012	3	0.004	2.955	.032[c]	0.005

a. Predictors: (Constant), SMB
b. Predictors: (Constant), SMB, HML
c. Predictors: (Constant), SMB, HML, MRK_RF

The complete coefficients output was presented in Appendix C and Table 13 were the list of the predictor variables that were not significant using the *t*-test where $p > .001$.

Only the unstandardized coefficients were considered since all the factors use the same units of measurements for all the variables or returns. In total, there were 270 coefficients that were examined based on 15 stocks for three models based on inclusion of factors based on the hierarchy methodology forced entry of SMB, HML, and MRK_RF factors, and over three periods. The constant or alpha was not presented since the purpose of the study was to examine the factors in the models.

The market premium (MRK_RF) was only non-significant in one case out of 45 and made a significant contribution to the model. The other factors, SMB and HML, made a non-significant contribution to the models 30% and 28% of the cases respectively (Table 14) and increased to 40% and 44% when only model 3 or the complete FF model was tested (Table 15). This indicated that when using the FF model for individual stocks, the addition of the SMB and HML factor could not contribute to the model on a consistent basis. As to the size of the stock or the period under investigation, there were no patterns that suggested that they made an effect to the contribution of the individual factors in the FF model.

The coefficients or the actual *b*-values was the relationship between the predictor (factor) and the outcome or the excess returns of the individual stock. The relationship or the *b*-values varied for all the stocks and the three-time periods and was expected because of the changing individual characteristics of a firm or firm specificity of the individual stocks and the changing economic conditions from one period or another. Another important consideration for coefficients or the *b*-values if they equaled 0. If any of the *b*-

values equaled 0, then there was no relationship between the excess return of the stock and the predictor (factor) in the model and would mean a Type 1 error and null hypothesis could not be rejected. Even though some of the *b*-values were very low, none of them equaled 0 and would have been a concern as to the contribution of the factor in the model.

Table 13

ANOVA (Non-significant) and Adjusted R^2

				Coefficients			
Stock	Period	Variable	Model	B	Std. Error	t	Sig.
3M Company Model	2015 - 2006	SMB	3	-0.031	0.031133308	-0.99	0.32
3M Company Model	2015 - 2006	HML	3	-0.054	0.028865226	-1.88	0.06
3M Company Model	2015 - 2011	SMB	3	-0.125	0.040981092	-3.05	0.00
3M Company Model	2015 - 2011	HML	3	0.048	0.045633902	1.05	0.29
3M Company Model	2010 - 2006	SMB	1	0.111	0.069892504	1.58	0.11
3M Company Model	2010 - 2006	SMB	2	0.187	0.065214909	2.86	0.00
3M Company Model	2010 - 2006	SMB	3	-0.010	0.045836935	-0.21	0.83
3M Company Model	2010 - 2006	HML	3	-0.050	0.039918087	-1.25	0.21
Allstate Corporation	2015 - 2006	SMB	1	0.117	0.074456493	1.57	0.12
Allstate Corporation	2015 - 2011	SMB	3	-0.086	0.050697442	-1.69	0.09
Allstate Corporation	2010 - 2006	SMB	1	-0.105	0.121826155	-0.86	0.39
Allstate Corporation	2010 - 2006	SMB	2	0.095	0.101421527	0.94	0.35
Allstate Corporation	2010 - 2006	SMB	3	-0.177	0.078614066	-2.25	0.02
Prudential Financial, Inc.	2015 - 2006	SMB	1	-0.026	0.11491558	-0.23	0.82
Prudential Financial, Inc.	2015 - 2006	SMB	2	0.287	0.094049534	3.05	0.00
Prudential Financial, Inc.	2015 - 2011	SMB	3	0.115	0.057439567	1.99	0.05
Prudential Financial, Inc.	2010 - 2006	SMB	2	-0.323	0.148233677	-2.18	0.03
IBM	2015 - 2011	HML	2	0.121	0.078511219	1.55	0.12
IBM	2010 - 2006	SMB	1	0.083	0.066092734	1.25	0.21
IBM	2010 - 2006	SMB	2	0.141	0.063339639	2.22	0.03
IBM	2010 - 2006	SMB	3	-0.052	0.043980176	-1.19	0.23

Occidental Petroleum	2015 - 2006	SMB	1	0.097	0.085492971	1.14	0.26
Occidental Petroleum	2015 - 2011	SMB	1	-0.347	0.134624326	-2.58	0.01
Occidental Petroleum	2015 - 2006	SMB	2	0.190	0.083558627	2.27	0.02
Occidental Petroleum	2010 - 2006	SMB	2	-0.259	0.131793264	-1.97	0.05
Occidental Petroleum	2015 - 2011	SMB	3	0.030	0.068825501	0.43	0.66
IAC Interactive	2015 - 2006	HML	3	-0.112	0.048336585	-2.32	0.02
IAC Interactive	2010 - 2006	HML	3	0.035	0.058330366	0.60	0.55
IAC Interactive	2015 - 2011	HML	2	-0.111	0.10759777	-1.04	0.30
IAC Interactive	2015 - 2011	SMB	3	0.164	0.086196835	1.90	0.06
NetApp, Inc.	2015 - 2006	SMB	3	0.146	0.066173297	2.21	0.03
NetApp, Inc.	2015 - 2011	HML	2	0.188	0.122692922	1.53	0.13
NetApp, Inc.	2015 - 2011	SMB	3	0.032	0.095616597	0.34	0.74
NetApp, Inc.	2015 - 2011	HML	3	-0.241	0.10647248	-2.26	0.02
NetApp, Inc.	2010 - 2006	SMB	3	0.253	0.093469881	2.70	0.01
Intercontinental Exchange	2015 - 2006	SMB	1	0.319	0.103674447	3.07	0.00
Intercontinental Exchange	2015 - 2006	SMB	3	-0.175	0.08385937	-2.09	0.04
Intercontinental Exchange	2015 - 2006	HML	3	0.158	0.077750158	2.04	0.04
Intercontinental Exchange	2015 - 2011	SMB	3	-0.107	0.068847817	-1.55	0.12
Intercontinental Exchange	2015 - 2011	HML	3	0.054	0.076664492	0.70	0.48
Intercontinental Exchange	2015 - 2006	SMB	1	0.168	0.175344227	0.96	0.34
Intercontinental Exchange	2015 - 2006	SMB	2	0.337	0.166336208	2.03	0.04
Intercontinental Exchange	2015 - 2006	SMB	2	-0.066	0.136840267	-0.48	0.63
Intercontinental Exchange	2015 - 2006	HML	3	0.015	0.119170309	0.13	0.90
Cablevision Systems Corp.	2015 - 2006	SMB	3	0.041	0.073366268	0.56	0.58
Cablevision Systems Corp.	2015 - 2011	HML	2	0.268	0.145090485	1.85	0.07
Cablevision Systems Corp.	2015 - 2011	SMB	3	0.039	0.12153362	0.32	0.75
Cablevision Systems Corp.	2015 - 2011	HML	3	-0.121	0.135332006	-0.89	0.37
Cablevision Systems Corp.	2015 - 2011	SMB	1	0.153	0.121001824	1.26	0.21
Cablevision Systems Corp.	2010 - 2006	SMB	2	0.298	0.110991544	2.68	0.01
Cablevision Systems Corp.	2015 - 2011	SMB	3	0.049	0.094587154	0.52	0.60
Masco Corp.	2015 - 2011	HML	3	0.139	0.113783756	1.22	0.22
National Penn Bancshares	2015 - 2006	HML	3	0.146	0.090680149	1.61	0.11
National Penn Bancshares	2015 - 2006	SMB	1	0.350	0.157799097	2.22	0.03
National Penn Bancshares	2015 - 2006	SMB	2	0.368	0.158295775	2.32	0.02

National Penn Bancshares	2015 - 2006	HML	2	0.158	0.119359179	1.33	0.19
National Penn Bancshares	2015 - 2006	SMB	3	0.340	0.159330899	2.14	0.03
National Penn Bancshares	2015 - 2006	HML	3	0.054	0.138756762	0.39	0.70
National Penn Bancshares	2015 - 2006	MRK_RF	3	0.115	0.077932414	1.47	0.14
Crawford & Company	2015 - 2006	HML	3	0.238	0.11193781	2.13	0.03
Crawford & Company	2015 - 2006	HML	3	0.070	0.15508131	0.45	0.65
Snyder's-Lance, Inc.	2015 - 2006	HML	3	0.042	0.056682953	0.75	0.45
Snyder's-Lance, Inc.	2015 - 2011	HML	3	0.114	0.086495872	1.31	0.19
Snyder's-Lance, Inc.	2010 - 2006	HML	3	0.046	0.079737124	0.58	0.56
Gorman-Rupp Company	2010 - 2006	HML	3	0.226	0.096791655	2.34	0.02
Universal Technical Institute	2010 - 2006	HML	3	0.197	0.102707552	1.92	0.06

Model 1: (Constant), SMB

Model 2: (Constant), SMB, HML

Model 3: (Constant), SMB, HML, MRK_RF

Table 14

Summary Coefficient Results (t-values, p > .001)

Summary	Tests	Non-significant (t-values, P > .001)	%
All Stocks	270	66	24%
Large	90	26	29%
Medium	90	0	0%
Small	90	14	16%
Model 1	45	11	24%
Model 2	90	16	18%
Model 3	135	39	29%
SMB	135	40	30%
HML	90	25	28%
MRK_RF	45	1	2%
Period 2015 - 2006	90	27	30%
Period 2015 - 2011	90	21	23%
Period 2010 - 2006	90	18	20%

Table 15

FF Model Summary Coefficient Results (t-values, p > .001)

Summary	Tests	Non-significant (t-values, P > .001)	%
Large	45	11	24%
Medium	45	0	0%
Small	45	11	24%
SMB	45	18	40%
HML	45	20	44%
MRK_RF	45	1	2%
Period 2015 - 2006	45	15	33%
Period 2015 - 2011	45	15	33%
Period 2010 - 2006	45	9	20%

The correlation matrix presented in Appendix D provided the Pearson's correlation between every pair of variables that included both the independent variables (factors) and the dependent variable (excess returns). A high correlation between the variables could be an indication of multicollinearity that could mean the results were skewed or provided misleading results. There was no correlation that was a concern between the factors with the highest correlation between the HML and MRK_RF factors for the period of 2010 – 2006 where $r = .503$. The highest correlation with the outcome variable or the excess return of the individual stock was consistently the market premium (MRK_RF), and at the highest was significant for the excess return of Prudential Financial Inc. for the period of 2015 – 2011 at a .01 level ($r = .823$, $p = .000$).

Another way to determine if there was collinearity in the data were through the VIF and tolerance statistics. The VIF and tolerance statistics were part of the coefficient SSPS output and was reviewed to determine if there were VIF statistic values below 0.2 or greater than 10 then could be a problem or cause of concern of collinearity (Field, 2013). In Table 16, the lowest VIF statistic was .734 and the highest of 1.362, and there was no concern of collinearity or bias in the model.

Table 16

Collinearity Statistics - Tolerance and VIF

		2015 - 2006		2015 - 2011		2010 - 2006	
Model		Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
1	(Constant)						
	SMB	1.000	1.000	1.000	1.000	1.000	1.000
2	(Constant)						
	SMB	.991	1.009	.984	1.017	.993	1.007
	HML	.991	1.009	.984	1.017	.993	1.007
3	(Constant)						
	SMB	.944	1.060	.836	1.196	.979	1.021
	HML	.807	1.239	.950	1.053	.734	1.362
	MRK_RF	.793	1.261	.837	1.195	.737	1.358

Residual statistics were performed on the data and was presented in Table 17 and represented the cases of the number of any residuals less than -2 or greater than 2. The expected cases of the sample should fall within -2 and +2 in this range or 95% and the sample of cases of 2,517, 1,258, and 1,259 and the acceptable number of cases was 126, 63, and 63 respectively or 5% of the sample cases. Of the 45 tests, only 6 tests produced cases of collinearity greater than 5% of the cases and was not a concern.

Table 17

Summary of Casewise Diagnostics greater than - 2 and + 2

	2015 - 2006	2015 - 2011	2010 - 2006
Total Cases	2517	1258	1259
Acceptable level of Cases greater than -2 and +2	126	63	63
3M Company	96	52	51
Allstate Corporation	109	47	56
Prudential Financial, Inc.	93	45	59
IBM	109	44	60
Occidental Petroleum Corporation	81	53	27
IAC Interactive	110	52	55
NetApp, Inc.	108	58	58
Intercontinental Exchange Inc.	114	68	58
Cablevision Systems Corp.	94	42	56
Masco Corp.	121	55	66
National Penn Bancshares, Inc.	131	47	63
Crawford & Company	140	62	66
Snyder's-Lance, Inc.	90	52	40
Gorman-Rupp Company	94	51	52
Universal Technical Institute, Inc.	93	42	53

For the first research question, the null hypothesis stated that the market capitalization as a proxy for size was not a significant predictor of future returns of a stock that used the FF model. The results of the multiple regression analysis confirmed that the null hypothesis should be rejected and the alternative hypothesis accepted. Therefore, market capitalization as a proxy for size in the FF model was a significant predictor of future excess returns of individual stocks. This was based on the statistical tests that were performed where the adjusted R^2 explained the variance of the predictor variable and the F-ratio were significant with some exceptions. There were 13 cases that had some issues with these tests and mainly were for large sized capitalized stocks but overall this was expected because of firm specific characteristics of individual stocks and the sample size compared to the population or one stock out of all the stocks on the U.S. Stock market or roughly the 3,000 stocks included in the Russell 3000 index. From these results, a finer classification for large sized market capitalization portfolios was used in the tests performed in the second research question. Instead of using the Russell Top 200 index, the portfolio that was tested used the Russell Top 50 index.

The other statistical results, correlation, *b*-values, and collinearity, also confirmed that the null hypothesis should be rejected. There were no anomalies or concerns with the correlations between variables. There were some low *b*-values but no values of 0, otherwise, this would have meant the model was not valid and no indication of substantive collinearity with no VIF value below .2 or above 10 and only a few cases of extreme outliers or 6 out of 45 cases.

Research Question #2: Two-Factor Model – 3 Portfolios

The two-factor model regression equation 8 was revised to test the model. Regression equation 13, presented below, included the excess returns of a portfolio returns in excess of the risk-free rate. A hierarchical regression was also used for the new size factor and with no value factor (HML) with the sequential order was the new size factor (SMMDMB), and then the new premium factor (N_Mrkt_RF). The statistical analysis that was performed was descriptive statistics, model summary, ANOVA, coefficients, collinearity diagnostics and casewise diagnostics.

Two-Factor Model – Regression equation 13

$$Rit - Rft = \beta i(Rmt - Rft) + siSMMDMBt + \varepsilon it \quad (13)$$

Fama-French Two-Factor Model (Fama & French, 1993) – Regression equation 14

$$Rit - Rft = \beta i(Rmt - Rft) + siSMBt + \varepsilon it \quad (14)$$

The new two-factor model was constructed with publicly available information like all the information that had been utilized for the study. This was to ensure that this study contributed to social change and in particular equity where any information used would be accessible by any average individual investor regardless of their financial resources. To meet this requirement and ensure the integrity of the study results, I constructed the new two-factor model based on past studies by Panta, et al., (2016) and Karki and Ghimire (2016) as guidelines. Both their studies outlined how they constructed not only the portfolios to be tested but also the construction of the factors in their models for their respective countries. The first step was to take the sample for each financial year under study and split into two groups based on market capitalization of small and large. The new two-factor model takes into consideration midsize stocks so for the sample it was divided between small, midsized, and large capitalized stocks and was the Russell 2000, Russell Midcap, and the Russell 200 indexes which were respectively, the bottom 2000, the next 800, and top 200 stocks of the Russell 3000. The next step I took was to break down each size category by book-to-market ratios into low, mid, and high using breakpoints 30%, 40%, and 30% respectively and then compute the SMB factor by formula 5 or small minus big. For the new two-factor model, formula 6 was used to calculate the SMMDMB or small minus mid minus big. The actual sorting by market cap and then by book-to-market to develop the small/high (S/H), small/mid (S/M), small/low (S/L), big/high (B/H), big/mid (B/M), and big/high (B/H) portfolios was not done in this study but rather Russell indexes were utilized based on their construction on price-to-book ratios for each sized index. In Table 18, Russell indexes were displayed along with their price-to-book ratios that were the opposite to the book-to-market ratio for April 30, 2017 to confirm character of the portfolio construction along with the new portfolios of mid/low (M/L), mid/mid (M/M), and mid/high (M/H). From the Russell indexes, the new SMMDMB factor was created for the three-time periods and for the new market premium(N_Mrk_Rf) was the Russell 3000 Index less the risk-free rate from the Kenneth R. French data library (French, 2017).

Table 18

Portfolios Based on Size and Price-to-Book Ratio

Portfolios		Price-to-book 30-Apr-17
Small Capitalized Portfolios		
Russell 2000® Value Index	S/L	1.63
Russell 2000® Index	S/M	2.33
Russell 2000® Growth Index	S/H	4.22
Mid-sized Capitalized Portfolios		
Russell Midcap® Value Index	M/L	1.97
Russell Midcap® Index	M/M	2.79
Russell Midcap® Growth Index	M/H	5.61
Large Capitalized Portfolios		
Russell Top 200® Value Index	B/L	2.07
Russell Top 200® Index	B/M	3.24
Russell Top 200® Growth Index	B/H	6.5

Sample Selection

The sample I selected for testing the new two-factor model was based on market capitalization or size. The three portfolios were chosen based on the size of small, mid, and large market capitalization and were the Russell 2000, Russell Midcap, and the Russell Top 50 Mega indexes. The Russell 2000 index consisted of small capitalized stocks or the bottom 2,000 stocks of the Russell 3000 index which measured the performance of the 3,000 largest publicly held companies in America based on capitalization or approximately 98% of the American public equity market (FTSE Russell, 2017). The Russell Midcap index consisted of the 800 of the smallest market capitalized stocks of the Russell 1000 index that included the top 1,000 market capitalized stocks in the Russell 3000 index. The Russell Top 50 Mega index consisted of the stocks that made up the top 50 stocks of the Russell Top 200 index. The reason I used the Russell Top 50 Mega index to represent large capitalized stocks over the Russell Top 200 was based on the results of the tests on individual stocks where seven cases of the large sized stocks with F-ratio of $P > .001$ and a very low adjusted R^2. The Russell Top 50 Mega index was a finer sample of larger sized capitalized stocks to determine if there were concerns regarding the new model in determining value for large sized stocks.

Statistical Results

The descriptive statistics for the three portfolios or indexes for the three-time periods were listed in Table 19. The average or mean daily returns of the three size portfolios, Russell 2000, Russell Midcap, and the Russell Top 50 Mega indexes, did vary from one period to another but was expected because the measure was on a daily basis and can be explained by the standard deviation. The only noticeable difference was the Russell Top 50 Mega index and as a percentage change was very high for the period of the financial crisis of 2008 (2010 – 2006) to the other periods and this could indicate that the crisis had a greater effect to large caps not only during the financial crisis but also the recovery from the financial shocks. The means of the daily returns also did not vary between the different sizes and could not support the size effect anomaly for this sample that was tested. For the factors, the only noticeable difference, like large caps, was the HML factor or value for the period of the financial crisis other periods. There was some noticeable difference between the new size factor to the FF model size factor but was expected because of the inclusion of midsize cap stocks. The new market premium varied a little but because of the unit of measurement and standard deviation was not a concern.

Table 19

Descriptive Statistics - Russell Indexes by Size Categories

	2015 - 2006			2015 - 2011			2010 - 2006		
Variable	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation	N
Top50	.0002061	.01244409	2517	.0004241	.00933753	1258	-.0000117	.01491629	1259
Midcap	.0002996	.01438746	2517	.0004228	.01067542	1258	.0001764	.01732321	1259
R2000	.0003020	.01661967	2517	.0003800	.01304287	1258	.0002240	.01955591	1259
SMMDMB	-.0002672	.01258019	2517	-.0004822	.00903275	1258	-.0000523	.01532659	1259
N_Mrkt_RF	.0002481	.01334574	2517	.0004283	.01002502	1258	.0000680	.01599160	1259
SMB	.0000367	.00593175	2517	-.0000695	.00516874	1258	.0001427	.00660712	1259
Mrkt_RF	.0003284	.01309726	2517	.0005020	.01002492	1258	.0001550	.01557552	1259
HML	-.0000393	.00691876	2517	-.0000789	.00435544	1258	.0000002	.00876245	1259

The model summary for the new two-factor model presented in Table 20 and provided the *R*, R^2 and adjusted R^2 for the new size factor that included mid-caps (SMMDMB) and the new market premium factor (N_Mrk_RF). Also presented was the FF model variables for only the size (SMB) and market premium (Mrk_RF) for comparison purposes to the new factors. The adjusted R^2 accounted for variance in excess returns of the stock or the dependent variable, was consistently high for all the indexes or portfolios for SMMDMB with a low adjusted R^2 of .416 to a high of .925. At the most, the new size factor accounted for 92.5% of the variance of excess returns of the Russell Top 50 Mega index for the period of 2015 – 2016 and the lowest for the Russell 2000 index of 41.6% for the period of 2015 – 2010. The new size factor explained the variance the least for small caps but was made up by the new market premium. The new market premium, when added to the model, contributed to explaining the variance to the excess returns and increased with size with the lowest contribution of 0.134 for the Russell Top Mega index for the period of 2015 – 2006 and to the highest contribution of .580 for the Russell 2000 index for the period of 2015 – 2010. There was a discernable change of the adjusted R^2 for the three periods for the new factors except for the old SMB factor which had other concerns. The Durbin-Watson statistic average was 1.921, with a low of 1.839 and high of 1.980 and no indication of autocorrelation or non-randomness that could arise through independent errors.

Table 20

Two-Factor Model Summary - Adjusted R^2

Portfolios	2015- 2006 R	R Square	Adjusted R Square	2015- 2011 R	R Square	Adjusted R Square	2010 - 2006 R	R Square	Adjusted R Square
Top50									
SMMDMB	.916[a]	.840	.840	.894[a]	.799	.799	.925[a]	.856	.856
SMMDMB, N_Mrkt_RF	.987[b]	.973	.973	.984[b]	.968	.968	.988[b]	.975	.975
SMB	.039[a]	.002	.001	.236[a]	.056	.055	.056[a]	.003	.002
SMB, Mrkt_RF	.990[b]	.979	.979	.987[b]	.975	.975	.990[b]	.981	.981
MidCap									
SMMDMB	.867[a]	.752	.752	.830[a]	.688	.688	.881[a]	.776	.776
SMMDMB, N_Mrkt_RF	.989[b]	.977	.977	.988[b]	.976	.976	.989[b]	.978	.978
SMB	.224[a]	.050	.050	.423[a]	.179	.178	.130[a]	.017	.016
SMB, Mrkt_RF	.990[b]	.979	.979	.988[b]	.977	.977	.991[b]	.981	.981
R2000									
SMMDMB	.703[a]	.494	.494	.645[a]	.416	.416	.727[a]	.529	.529
SMMDMB, N_Mrkt_RF	.998[b]	.995	.995	.998[b]	.996	.996	.997[b]	.995	.995
SMB	.451[a]	.204	.203	.645[a]	.417	.416	.353[a]	.124	.124
SMB, Mrkt_RF	.993[b]	.986	.986	.997[b]	.993	.993	.993[b]	.985	.985

The size factor for the FF model (SMB) had a very low adjusted R^2 for all indexes and periods. This was very concerning for performance of the model since the adjusted R^2 was negligible or .001 or not even 1% explanation of the variance of excess returns. The SMB data were re-examined to make sure there was no error in the data input process, and this was not the issue. The model was retested using other Russell indexes, and the results were in line with the original tests and were displayed in Table 21. Further tests were performed based on these results of collinearity with the market premium factor.

Table 21

SMB Factor Model Summary - Adjusted R²

Portfolios	Description	R	R Square	Adjusted R Square
Small Cap Completeness Index	Russell 3000 stocks that are not represented in the Standard & Poor's 500 index	.353a	.125	.124
Russell 2500 index	2,500 smallest companies in the Russell 3000 index	.365a	.133	.133
Russell 1000 index	The top 1,000 stocks on the Russell 3000 index	.122a	.015	.014
Russell Top 200 index	The top 200 stocks on the Russell 200 index	.074a	.006	.005

The ANOVA analysis for the three Russell indexes for the three periods were presented in Table 22. For both the new two-factor model and the FF model with only two factors, the *F*–ratio was significant or where $P < .001$ for all time periods, and indicated all the models improved the predictability of the outcome and the variance in excess returns of the Russell indexes.

Table 22

ANOVA Analysis - Two-factor Model

	2015 - 2006		2015 - 2011		2010 - 2006	
	F	Sig.	F	Sig.	F	Sig.
Top50						
SMMDMB	13185.064	0.00	5003.719	0.00	7456.630	0.00
SMMDMB, N_Mrkt_RF	45788.939	0.00	19101.036	0.00	24846.476	0.00
SMB, Mrkt_RF	59036.534	0.00	24338.738	0.00	32200.225	0.00
Midcap						
SMMDMB	7629.225	0.00	2773.401	0.00	4363.544	0.00
SMMDMB, N_Mrkt_RF	54285.808	0.00	25523.601	0.00	28055.607	0.00
SMB, Mrkt_RF	59120.524	0.00	26580.382	0.00	33290.800	0.00
R2000						
SMMDMB	2457.344	0.00	895.538	0.00	1411.346	0.00
SMMDMB, N_Mrkt_RF	254020.174	0.00	149107.478	0.00	121428.279	0.00
SMB, Mrkt_RF	90356.830	0.00	91941.129	0.00	41887.657	0.00

The coefficients output in Table 23 provided the *b*-values for the two-factor model and the FF model with only two factors for the three portfolios over the three periods. The *b*-values were fairly consistent between the three periods with largest change for the SMB factor of 14% where the coefficient decreased from .186 (2010 – 2006) to .161 (2015 – 2006). The lowest *b*-values were for the new SMMDMB factor Russell Midcap Index and was .095 (2015 – 2006), .101 (2015 – 2006), and .097 (2010 – 2006). Also, the SMB factor was very low during this period. No *b*-values equaled 0 and indicated that there was no relationship between the factor and the dependent variable or excess returns. An important result was that all the *t*-tests had p < .001 and meant all the predictor variables were significant and affected the excess returns of the three portfolios and in each of the three periods.

Table 23

Coefficients - Two-Factor Model

	2015 - 2006				2015 - 2011				2010 - 2006			
	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
Top50												
SMMDMB	-.183	.007	-25.334	0.000	-.200	.010	-19.413	0.000	-.176	.010	-17.193	0.000
N_Mrkt_RF	.762	.007	112.065	0.000	.757	.009	81.621	0.000	.766	.010	78.062	0.000
SMB	-.255	.006	-41.733	0.000	-.253	.009	-29.163	0.000	-.259	.009	-29.393	0.000
Mrkt_RF	.952	.003	343.344	0.000	.959	.004	214.248	0.000	.949	.004	253.370	0.000
Midcap												
SMMDMB	.095	.008	12.393	0.000	.101	.010	9.860	0.000	.097	.011	8.636	0.000
N_Mrkt_RF	1.145	.007	158.199	0.000	1.129	.009	122.671	0.000	1.155	.011	107.582	0.000
SMB	.161	.007	22.733	0.000	.150	.010	15.741	0.000	.186	.010	18.483	0.000
Mrkt_RF	1.073	.003	334.976	0.000	1.022	.005	208.408	0.000	1.094	.004	255.807	0.000
R2000												
SMMDMB	.943	.004	227.989	0.000	.943	.005	180.828	0.000	.946	.006	154.436	0.000
N_Mrkt_RF	1.973	.004	505.691	0.000	1.958	.005	416.613	0.000	1.981	.006	337.254	0.000
SMB	.861	.007	129.774	0.000	.877	.006	139.243	0.000	.879	.010	86.462	0.000
Mrkt_RF	1.137	.003	378.642	0.000	1.061	.003	326.761	0.000	1.167	.004	270.564	0.000

The correlation matrix was presented in Table 24 for the new two-factor model and Table 25 for the FF model with only two variables. For the two-factor model, the results showed a high correlation between all the variables and varied slightly for the three periods and the three portfolios, but nothing indicated there was a significant change in the relationships between the variables. The magnitude of the correlation was very high, and the majority of the cases was greater than $r > .9$ and an indication there could be multicollinearity issues between the variables. This high result was to be expected because of the construction of the independent variables (size and market premium) which were based on the sample population or the dependent variables. The concern of the correlation was the size variable (SMMDMB) that had a negative correlation to the other variables. This negative correlation anomaly was not a proper relationship between variables in determining the value of a security or portfolio of securities and was reviewed and discussed in additional tests.

Table 24

Correlations - Two-Factor Model

Pearson Correlation	2015 - 2006			2015 - 2011			2010 - 2006		
	Top50	SMMDMB	N_Mrkt_RF	Top50	SMMDMB	N_Mrkt_RF	Top50	SMMDMB	N_Mrkt_RF
Top50	1.000	-.916	.983	1.000	-.894	.979	1.000	-.925	.985
SMMDMB	-.916	1.000	-.895	-.894	1.000	-.863	-.925	1.000	-.907
N_Mrkt_RF	.983	-.895	1.000	.979	-.863	1.000	.985	-.907	1.000
	Midcap	SMMDMB	N_Mrkt_RF	Top50	SMMDMB	N_Mrkt_RF	Top50	SMMDMB	N_Mrkt_RF
Midcap	1.000	-.867	.988	1.000	-.830	.987	1.000	-.881	.988
SMMDMB	-.867	1.000	-.895	-.830	1.000	-.863	-.881	1.000	-.907
N_Mrkt_RF	.988	-.895	1.000	.987	-.863	1.000	.988	-.907	1.000
	R2000	SMMDMB	N_Mrkt_RF	Top50	SMMDMB	N_Mrkt_RF	Top50	SMMDMB	N_Mrkt_RF
R2000	1.000	-.703	.945	1.000	-.645	.942	1.000	-.727	.947
SMMDMB	-.703	1.000	-.895	-.645	1.000	-.863	-.727	1.000	-.907
N_Mrkt_RF	.945	-.895	1.000	.942	-.863	1.000	.947	-.907	1.000

The correlation matrix for the FF model with only two variables was presented in Table 25. The relationship of the market premium variable (Mrkt RF) was high and over

$r > .9$ The magnitude of the correlation was very high and in the majority of the cases was greater than $r > .9$ and was expected and did not vary for the periods or the portfolios. Unlike the new size variable, the FF model size variable was less than the market premium and was only negative in one circumstance or for the Russell Top 50 portfolio for the period of the financial crisis (2010 – 2006) and was very small and not significant at a .01 level ($r = -.056$, $p = .024$). The relationship of the size variable (SMB) also varied for each period and between the portfolios and should be expected as this a factor that was included to provide better understanding of the dependent variable or in this test to portfolios based on the three different size indexes.

Table 25

Correlations - FF Factor Two-Factor Model

Pearson Correlation	2015 - 2006			2015 - 2011			2010 - 2006		
	Top50	SMB	Mrkt_RF	Top50	SMB	Mrkt_RF	Top50	SMB	Mrkt_RF
Top50	1.000	0.039	.982	1.000	0.236	.979	1.000	-0.056	.984
SMB	.039	1.000	.161	.236	1.000	.365	-.056	1.000	.060
Mrkt_RF	.982	.161	1.000	.979	.365	1.000	.984	.060	1.000
	Midcap	SMB	Mrkt_RF	Top50	SMB	Mrkt_RF	Top50	SMB	Mrkt_RF
Midcap	1.000	.224	.987	1.000	.423	.986	1.000	.130	.988
SMB	.224	1.000	.161	.423	1.000	.365	.130	1.000	.060
Mrkt_RF	.987	.161	1.000	.986	.365	1.000	.988	.060	1.000
	R2000	SMB	Mrkt_RF	Top50	SMB	Mrkt_RF	Top50	SMB	Mrkt_RF
R2000	1.000	.451	.946	1.000	.645	.943	1.000	.353	.947
SMB	.451	1.000	.161	.645	1.000	.365	.353	1.000	.060
Mrkt_RF	.946	.161	1.000	.943	.365	1.000	.947	.060	1.000

Another way it was determined if there was collinearity in the data were through the VIF and tolerance statistics. The VIF and tolerance statistics were part of the coefficient SSPS output and was reviewed to determine if there were VIF values below

0.2 or greater than 10 then could be a problem or cause of concern of collinearity (Field, 2013). In Table 26, the lowest VIF was 1.000 and the highest of 5.632 and could not be a great concern of collinearity, but there was biased in the result. For the FF model, it was 1.004, and no collinearity or bias existed.

Table 26

Collinearity Statistics - Tolerance and VIF

		2015 - 2006		2015 - 2011		2010 - 2006	
Model		Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Two-Factor Model - 1 Variable	SMMDMB	1.000	1.000	1.000	1.000	1.000	1.000
Two-Factor Model	SMMDMB	0.200	5.010	0.256	3.909	0.178	5.632
	N_Mrkt_RF	0.200	5.010	0.256	3.909	0.178	5.632
FF model Two-Factors	SMB	0.974	1.027	0.867	1.154	0.996	1.004
	Mrkt_RF	0.974	1.027	0.867	1.154	0.996	1.004

Residual statistics were performed on the data and was presented in Table 27 and represented the cases the number of any residuals less than -2 or greater than 2. The expected cases of the sample should fall within -2 and +2 in this range or 95% and since there were 2,517, 1,258, and 1,259 for the three periods then there should only be 5% or less to fall outside this range or roughly 126, 63, and 63. Of the 18 cases for the two models and three portfolios, 8 cases fell over this range, and in 5 of the cases were for the 2010 – 2006 period or when the financial crisis occurred and could explain the collinearity.

Table 27

Summary of Casewise Diagnostics greater than - 2 and + 2

		2015 - 2006	2015 - 2011	2010 - 2006
Total Cases		2517	1258	1259
Acceptable level of Cases greater than -2 and +2		126	63	63
Two-factor model	Russell Top 50 Mega	126	62	68
Two-factor model	Russell Mid	118	56	68
Two-factor model	Russell 2000	123	58	63
FF two-factor model	Russell Top 50 Mega	125	66	66
FF two-factor model	Russell Mid	129	56	67
FF two-factor model	Russell 2000	123	65	67

For the second research question, the null hypothesis that was tested was that a two-factor model that used mid-cap portfolio for the size factor did not explain or predict the returns of different sized portfolios (small, mid, and big) accurately. A two-factor FF model was also tested to compare the results of the proposed new two-factor model for comparison and validity purposes. The results for the two-factor model for the ANOVA analysis, the adjusted R^2 of the 3 portfolios was consistently high, and the model explained the variance in excess returns. the F-ratio was significant or where $P < .001$ for all time periods and indicated that two-factor models improved the predictability of outcomes. No b-values equaled 0, and all the predictor variables were significant based on the results of the t-tests that had $p < .001$.

The post hoc test results for collinearity indicated this was not a concern. the lowest VIF was 1.000 and the highest of 5.632 and was within the .2 to 10 range and indicated there was some bias. There was an issue with the casewise diagnostics, but the cases of extreme outliers occurred during the financial crisis period and could explain this result.

From the statistical results presented, the null hypothesis should be rejected, but one outstanding issue was apparent from the Pearson correlation results that showed a negative relationship of the new size factor (SMMDMD) with the other variables. The negative result was compared to the results of the FF model and the size factor (SMB) and was positive. This result was not consistent with the size effect anomaly or the basis of the creation of the size factor where small market caps tended to outperform big market cap stocks and should have a positive relationship in normal market conditions across the majority of the firms traded in a financial market with exceptions based on firm specific characteristics. Based on the negative correlation across all time periods the null hypothesis cannot be rejected, and the model was not a good fit to the data analyzed for the portfolios based on size. Research question three went further in the portfolios that were tested to include value and growth portfolios and the results presented next confirmed this assertion.

Research Question #3: Two-Factor Model – 9 Portfolios

The two-factor model regression that was tested in research question two and compared with the FF model with only two factors to make sure that the new size factor was as rigorous as the size factor in the original model. Also, the new model also included a new market premium factor based on the excess returns of the Russell 3000 where the FF model constructed the returns of the U.S. stock exchanges (NYSE, NASDAQ, and AMEX) and used data collected from the Center for Research Security

Price Prices (CRSP). To be consistent with the methodology in the construction of the new size model the Russell index was used.

Sample Selection

The sample that was used in research question two were three portfolios based on size classification using Russell indexes. For testing question three, the sample that was tested includes a finer construction of the portfolios by book-to-market. In current and research studies based on the original Fama-French study (Fama & French, 1993), researchers like Panta, et al., (2016) and Karki and Ghimire (2016) constructed portfolio siz portfolios based on the size and book-to-market ratio of firms. The portfolios were constructed with the same methodology to produce the size (SM) and value (HML) factors in the FF model.

The six portfolios were constructed by grouping stocks into size categories of the market capitalization of small and big. The small and large cap stocks were then broken by book-to-market ratios into low, mid, and high using breakpoints 30%, 40%, and 30% respectively and the 6 portfolios were described as small/high (S/H), small/mid (S/M), small/low (S/L), big/high (B/H), big/mid (B/M), and big/high (B/H) portfolios. The six portfolios (2 size x 3 B/M) does not include mid-caps in the first step for size classification and for research question three the mid-caps were included to test nine portfolios (3 size x 3 B/M) to include new portfolios of mid/low (M/L), mid/mid (M/M), and mid/high (M/H). The size classification breakdown of small sized stocks or the bottom 30%, midsized stocks or middle 40% and large sized stocks or the top 30%. Then each size classification was broken down further with the low book-to-market stocks, the bottom 30%, mid book-to-market stocks, middle 40%, and high book-to-market stocks or the top 30%. This will produce the nine portfolios and represents portfolios low book-to-market stocks in each size classification or described as value stocks, mid book-to-market stocks in each size classification, and high book-to-market ratios in each size classification or growth. To be consistent with the construction of the factors in the new two-factor model the Russell indexes were used for the sample to be tested and were listed in Table 18 and were the Russell 2000 Value index (S/L), Russell 2000 index (S/M), Russell 2000 Growth index (S/H), Russell Midcap Value index (M/L), Russell Midcap index (M/M), Russell Midcap Growth index (M/H), Russell Top 200 Value index (B/L), Russell Top 200 index (B/M), and Russell Top 200 Growth index (B/H).

Statistical Results

The descriptive statistics for the nine portfolios for the three-time periods were listed in Table 28. The average or mean daily returns of the six portfolios for the small and midsized portfolios for the three periods varied but not significantly and was expected based on the daily measure of excess returns and the randomness of financial markets (Random walk hypothesis). Again, the large sized portfolios showed some significant changes for the three periods, and the extreme change was for the Russell Top 200 and were the period of the financial crisis (2010 – 2006) of a mean of .0000126 to after the financial crisis of .0004393 (2015 – 2011) and for the whole period .0002259 (2015 – 2006). This pattern was repeated between the size categories and also within the three large sized portfolios. The period of the financial crisis affected the large sized portfolios and in particular the value the Russell Top 200 and had a negative mean of excess returns of -.0000459. This also had an effect on the size factor which had a negative mean of excess returns of -.0000523 (SMMDMB) for the period of the financial crisis but continued afterward (2015 – 2011) and for the whole period (2015 – 2006).

Table 28

Descriptive Statistics - 9 Portfolios

	2015 - 2006			2015 - 2011			2010 - 2006		
Variable	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation	N
R2000V	.0002348	.01705167	2517	.0002911	.01263036	1258	.0001785	.02054540	1259
R2000	.0003020	.01661967	2517	.0003800	.01304287	1258	.0002240	.01955591	1259
R2000G	.0003701	.01644921	2517	.0004701	.01368712	1258	.0002701	.01881343	1259
MidV	.0002629	.01461024	2517	.0003917	.01048830	1258	.0001342	.01780360	1259
Mid	.0002996	.01438746	2517	.0004228	.01067542	1258	.0001764	.01732321	1259
MidG	.0003306	.01444146	2517	.0004531	.01106011	1258	.0002082	.01717127	1259
T200V	.0001628	.01398799	2517	.0003717	.00995182	1258	-.0000459	.01709621	1259
T200	.0002259	.01279507	2517	.0004393	.00959707	1258	.0000126	.01533969	1259
T200G	.0002934	.01204262	2517	.0005080	.00955482	1258	.0000790	.01409736	1259
N_Mrkt_RF	.0002481	.01334574	2517	.0004283	.01002502	1258	.0000680	.01599160	1259
SMMDMB	-.0002672	.01258019	2517	-.0004822	.00903275	1258	-.0000523	.01532659	1259

The model summary for the nine portfolios was presented in Table 29 and provided the adjusted R^2 for the new market premium factor (N_Mrk_RF) and based on the hierarchy order the new size factor (SMMDMB) was added to the model. The adjusted R^2 was high in all cases between .866 to .997, or the models accounted for the variance of the excess returns of the portfolios 86.6% to 99.7 % variance. The data revealed that when the size factor (SMMDMB) was added based on the hierarchy regression, the contribution of the factor was minimal for the Russell 2000 portfolio ranging from 5% to 6% and for the other portfolios, when rounded, 0. This essentially would have meant that the new size variable adds nothing to the model and to check this assertion, the results from the previous testing for research question two where the hierarchical order was the reverse indicated that the factor does contribute to explaining the variance in the dependent variance or the excess returns of the portfolios. In Table 30, the size factor (SMMDMB) when changed in the hierarchical order to first contributed from .416 to .881 for all cases for the Russell Midcap index and the Russell 2000 index. The Durbin-Watson statistic average was 1.959, with a low of 1.869 and high of 2.187 and no indication of autocorrelation or non-randomness.

Table 29

Adjusted R^2 - 9 Portfolios

	2015- 2006			2015- 2011			2010 - 2006		
Portfolios	R	R^2	Adj. R^2	R	R^2	Adj. R^2	R	R^2	Adj. R^2
R2000V									
N_Mrkt_RF	0.938	0.879	0.879	0.936	0.875	0.875	0.938	0.881	0.881
N_Mrkt_RF, SMMDMB	0.990	0.980	0.980	0.989	0.978	0.978	0.992	0.984	0.984
R2000									
N_Mrkt_RF	0.945	0.893	0.893	0.942	0.887	0.887	0.947	0.897	0.897
N_Mrkt_RF, SMMDMB	0.998	0.995	0.995	0.998	0.996	0.996	0.997	0.995	0.995
R2000G									
N_Mrkt_RF	0.937	0.878	0.878	0.931	0.866	0.866	0.943	0.889	0.889
N_Mrkt_RF, SMMDMB	0.988	0.977	0.977	0.989	0.977	0.977	0.989	0.978	0.978
MidV									
N_Mrkt_RF	0.981	0.962	0.962	0.980	0.960	0.960	0.981	0.963	0.963
N_Mrkt_RF, SMMDMB	0.981	0.963	0.963	0.980	0.961	0.961	0.983	0.965	0.965
Mid									
N_Mrkt_RF	0.988	0.976	0.976	0.987	0.974	0.974	0.988	0.977	0.977
N_Mrkt_RF, SMMDMB	0.989	0.977	0.977	0.988	0.976	0.976	0.989	0.978	0.978
MidG									
N_Mrkt_RF	0.977	0.954	0.954	0.975	0.951	0.951	0.977	0.955	0.955
N_Mrkt_RF, SMMDMB	0.977	0.955	0.955	0.977	0.954	0.954	0.978	0.956	0.956
T200V									
N_Mrkt_RF	0.980	0.961	0.961	0.978	0.957	0.957	0.982	0.963	0.963
N_Mrkt_RF, SMMDMB	0.983	0.966	0.966	0.981	0.963	0.963	0.984	0.968	0.968
T200									
N_Mrkt_RF	0.995	0.989	0.989	0.994	0.987	0.987	0.995	0.990	0.990
N_Mrkt_RF, SMMDMB	0.997	0.994	0.994	0.996	0.993	0.993	0.997	0.994	0.994
T200G									
N_Mrkt_RF	0.979	0.958	0.958	0.977	0.955	0.955	0.980	0.961	0.961
N_Mrkt_RF, SMMDMB	0.981	0.962	0.962	0.980	0.960	0.960	0.982	0.965	0.964

Table 30

Adjusted R^2 - SMMDMB Check

Portfolios	2015- 2006 R	R^2	Adj. R^2	2015- 2011 R	R^2	Adj. R^2	2010 - 2006 R	R^2	Adj. R^2
Mid									
N_Mrkt_RF	0.988	0.976	0.976	0.987	0.974	0.974	0.988	0.977	0.977
N_Mrkt_RF, SMMDMB	0.989	0.977	0.977	0.988	0.976	0.976	0.989	0.978	0.978
SMMDMB Contribution	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001
MidCap - Research Question #2									
SMMDMB	0.867	0.752	0.752	0.830	0.688	0.688	0.881	0.776	0.776
R2000									
N_Mrkt_RF	0.945	0.893	0.893	0.942	0.887	0.887	0.947	0.897	0.897
N_Mrkt_RF, SMMDMB	0.998	0.995	0.995	0.998	0.996	0.996	0.997	0.995	0.995
SMMDMB Contribution	0.053	0.102	0.102	0.056	0.109	0.109	0.050	0.098	0.098
R2000 - Research Question #2									
SMMDMB	0.703	0.494	0.494	0.645	0.416	0.416	0.727	0.529	0.529

The ANOVA analysis for the nine Russell indexes for the three periods was presented in Table 31. The *F*-ratio was significant or where $P < .001$ for all time periods and portfolios and indicated all the models improved the predictability of the outcome and the variance in excess returns of the Russell indexes.

Table 31

ANOVA Analysis - 9 Portfolios

	2015 - 2006		2015 - 2011		2010 - 2006	
	F	Sig.	F	Sig.	F	Sig.
R2000V						
N_Mrkt_RF	18,270	0.00	8810.08	0.00	9276.56	0.00
N_Mrkt_RF, SMMDMB	62,511	0.00	27569.50	0.00	39208.87	0.00
R2000						
N_Mrkt_RF	21,048	0.00	9821.89	0.00	10964.89	0.00
N_Mrkt_RF, SMMDMB	254,020	0.00	149107.48	0.00	121428.28	0.00
R2000G						
N_Mrkt_RF	18,045	0.00	8107.33	0.00	10094.74	0.00
N_Mrkt_RF, SMMDMB	52,308	0.00	26847.89	0.00	28040.13	0.00
MidV						
N_Mrkt_RF	63,014	0.00	30171.83	0.00	32928.54	0.00
N_Mrkt_RF, SMMDMB	32,785	0.00	15428.35	0.00	17491.00	0.00
Mid						
N_Mrkt_RF	102,216	0.00	47324.89	0.00	52937.55	0.00
N_Mrkt_RF, SMMDMB	54,286	0.00	25523.60	0.00	28055.61	0.00
MidG						
N_Mrkt_RF	52,256	0.00	24535.54	0.00	26947.41	0.00
N_Mrkt_RF, SMMDMB	26,922	0.00	13098.63	0.00	13687.85	0.00
T200V						
N_Mrkt_RF	61,493	0.00	28047.16	0.00	33101.82	0.00
N_Mrkt_RF, SMMDMB	35,601	0.00	16284.40	0.00	18909.30	0.00
T200						
N_Mrkt_RF	234,177	0.00	96491.75	0.00	127775.27	0.00
N_Mrkt_RF, SMMDMB	203,444	0.00	86458.68	0.00	109922.12	0.00
T200G						
N_Mrkt_RF	57,643	0.00	26843.95	0.00	31119.19	0.00
N_Mrkt_RF, SMMDMB	31,524	0.00	15238.08	0.00	17077.30	0.00

The two-factor coefficients *b*-values and *t* - tests were presented in Table 32 for the nine portfolios over the three periods. For all the portfolios and time periods, the *t*-tests had $p < .001$ and meant all the predictor variables were significant and affected the excess returns of the three portfolios. The Russell 2000 value, Russell 2000, and Russell growth coefficients for both variables (market premium and size) were fairly consistent for the three periods. The other portfolios, Russell Mid Cap and Russell Top 200 group of portfolios, the *b*-values for the market premium variable (N_Mrkt_RF) were fairly consistent for the three periods. This was not true for the size variable (SMMDMB), and the positive *b*-values were extremely low and ranged from .07 to a high of .013. The negative *b*-values were extremely low and ranged from -.18 to a high of -.013. Even though the *b*-values were not 0, no relationship to the dependent variable, the low coefficients indicated that the relationship of the size variable was very minimal and could not be a viable factor.

Table 32

Coefficients - 9 Portfolios

	2015 - 2006				2015 - 2011				2010 - 2006			
	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
R2000V												
N_Mrkt_RF	2.01	0.008	251.274	0.000	1.87	0.010	177.961	0.000	2.10	0.011	193.999	0.000
SMMDMB	0.97	0.008	113.657	0.000	0.89	0.012	76.037	0.000	1.02	0.011	90.839	0.000
R2000												
N_Mrkt_RF	1.97	0.004	505.691	0.000	1.96	0.005	416.613	0.000	1.98	0.006	337.254	0.000
SMMDMB	0.94	0.004	227.989	0.000	0.94	0.005	180.828	0.000	0.95	0.006	154.436	0.000
R2000G												
N_Mrkt_RF	1.93	0.008	229.068	0.000	2.05	0.012	177.790	0.000	1.86	0.012	159.869	0.000
SMMDMB	0.92	0.009	102.910	0.000	1.00	0.013	78.206	0.000	0.87	0.012	71.365	0.000
MidV												
N_Mrkt_RF	1.16	0.009	123.223	0.000	1.08	0.012	93.396	0.000	1.20	0.014	86.657	0.000
SMMDMB	0.10	0.010	9.953	0.000	0.07	0.013	5.323	0.000	0.13	0.014	8.745	0.000
Mid												
N_Mrkt_RF	1.15	0.007	158.199	0.000	1.13	0.009	122.671	0.000	1.15	0.011	107.582	0.000
SMMDMB	0.10	0.008	12.393	0.000	0.10	0.010	9.860	0.000	0.10	0.011	8.636	0.000
MidG												
N_Mrkt_RF	1.14	0.010	111.288	0.000	1.18	0.013	89.541	0.000	1.11	0.015	73.755	0.000
SMMDMB	0.09	0.011	8.592	0.000	0.13	0.015	9.048	0.000	0.07	0.016	4.477	0.000
T200V												
N_Mrkt_RF	0.88	0.009	101.401	0.000	0.84	0.011	78.965	0.000	0.90	0.013	69.811	0.000
SMMDMB	-0.18	0.009	-19.556	0.000	-0.17	0.012	-13.956	0.000	-0.18	0.013	-13.173	0.000
T200												
N_Mrkt_RF	0.83	0.003	246.012	0.000	0.83	0.005	182.674	0.000	0.82	0.005	169.996	0.000
SMMDMB	-0.15	0.004	-42.850	0.000	-0.16	0.005	-31.353	0.000	-0.15	0.005	-29.965	0.000
T200G												
N_Mrkt_RF	0.78	0.008	98.506	0.000	0.81	0.011	77.035	0.000	0.75	0.011	67.855	0.000
SMMDMB	-0.13	0.008	-15.063	0.000	-0.15	0.012	-12.779	0.000	-0.13	0.012	-10.900	0.000

The correlation matrix for the new two-factor model was presented in Table 33 for the nine portfolios. The results reflect the correlation results for research question two and showed a high correlation between all the variables and varied slightly for the three periods and between the three portfolios. The magnitude of the correlation was very high, and in the majority of the cases were greater than $r > .9$ and was to be expected because of the construction of the independent variables (size and market premium) and were based on the sample population or the dependent variables. Again, the concern of the correlation was the size variable (SMMDMB) and had a negative correlation to the other variables. This anomaly was not a proper relationship between variables in determining the value of a security or portfolio of securities and was reviewed and discussed in other tests.

Table 33

Negative Correlations - 9 Portfolios

Pearson Correlation	2015 - 2006	2015 - 2011	2010 - 2006
	SMMDMB	SMMDMB	SMMDMB
R2000V	-.697	-.645	-.715
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
R2000	-.703	-.645	-.727
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
R2000G	-.698	-.634	-.730
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000

	SMMDMB	SMMDMB	SMMDMB
MidV	-.860	-.830	-.871
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000

	SMMDMB	SMMDMB	SMMDMB
Mid	-.867	-.830	-.881
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000

	SMMDMB	SMMDMB	SMMDMB
MidG	-.858	-.814	-.875
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000

	SMMDMB	SMMDMB	SMMDMB
T200V	-.909	-.882	-.918
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000

	SMMDMB	SMMDMB	SMMDMB
	-.920	-.895	-.929
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000

	SMMDMB	SMMDMB	SMMDMB
T200G	-.902	-.879	-.914
N_Mrkt_RF	-.895	-.863	-.907
SMMDMB	1.000	1.000	1.000

The VIF statistics, presented in Table 34, was as low of 1.000 and the highest of 5.632 and this did not show any concern of collinearity, but there was some bias between the variables. The VIF values were not below 0.2 or greater than 10, otherwise it would have been a cause of concern of collinearity.

Table 34

Collinearity Statistics - Tolerance and VIF

		2015 - 2006		2015 - 2011		2010 - 2006	
Model		Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Model 1 - 1 Variable	N_Mrkt_RF	1.000	1.000	1.000	1.000	1.000	1.000
Model 2 - 2 Variables	N_Mrkt_RF	0.200	5.010	0.256	3.909	0.178	5.632
	SMMDMB	0.200	5.010	0.256	3.909	0.178	5.632

The casewise diagnostic for the nine portfolios and three-time periods were presented in Table 35. The acceptable cases of less than -2 or greater than 2 for cases of 2,517, 1,258, and 1,259 was 126, 63, and 63 where there were extreme outliers. Of the 27 cases, 15 cases fell over this range, and 8 of the cases were for the period of 2010 – 2006 or when the financial crisis occurred. The remaining 7 cases over the periods where for the growth and value portfolios and specifically for the Russell 2000 value, Russell 2000 growth, Russell Midcap growth, and the Russell Top 200 value portfolios and none for the portfolios based on size only.

Table 35

Summary of Casewise Diagnostics greater than - 2 and + 2

	2015 - 2006	2015 - 2011	2010 - 2006
Total Cases	2517	1258	1259
Acceptable level of Cases greater than -2 and +2	126	63	63
R2000V	137	70	65
R2000	123	58	63
R2000G	128	65	73
MidV	125	60	56
Mid	118	56	68
MidG	134	66	72
T200V	122	65	73
T200	122	58	70
T200G	122	60	65

The third research question expanded on the sample that was tested for the three size portfolios that included value and growth portfolios. The mean, from the descriptive statistics, the large sized portfolios (Russell Top 200) showed some significant changes for the three periods, and the extreme change was for the period of the financial crisis (2010 – 2006). The adjusted R^2 was consistent for the model but was very low and insignificant when reviewed on the hierarchical order and appeared the new size factor (SMMDMB) did not add to the explanation of the variance of the dependent variable and an additional test was performed with the hierarchical order changed and showed that there was a significant adjusted R^2. The *F*- ratio was significant or where $P < .001$ the *t*-tests had $p < .001$ and the size variable (SMMDMB) and the positive *b*-values were extremely low and ranged from .07 to a high of .013 & -.18 to a high of -.013. The determination of extreme outliers did show some concern for the casewise cases that were more than the level of 2 standard deviations of the mean. The growth and value portfolios, the Russell 2000 value, Russell 2000 growth, Russell Midcap growth, and the Russell Top 200 value portfolios, had more cases than the acceptable level but occurred during the period of the financial crisis to explain the high number of cases.

The Pearson correlation results again showed a negative relationship of the new size factor (SMMDMD) with the other variables in the new added value and growth portfolios. The null hypothesis cannot be rejected based on this negative correlation. Based on these results, a re-examination of the construction of the new size factor (SMMDMB) was performed and changed, and a revised two-factor model was tested and was presented next with a newly constructed size factor (SMBPMD).

Research Question #3: Revised Two-Factor Model

The revised two-factor model included a size factor and was now small sized stocks minus large sized stock plus midsized stock based on a 3x3 sort first by size then by book-to-market. The size factor theorized and constructed in the original two-factor model was erroneously designed to include midsize stocks to produce a finer size classification to produce a better valuation model. This assumed subtracting the new midsize classification when it should have been added based on the size effect anomaly where small caps outperform large caps or could be stated as large caps underperform small caps. Therefore, the new size factor (SMBPMD), stated in regression equation 15, added the mid-cap portfolios based on the results of the statistical tests from the results of research question two and three. The new size factor was re-tested for research question three.

Revised Small minus Big plus Mid – Independent variable equation 15

SMBPMD = (S/H +S/M +S/L)/3 – (B/H+B/M+B/L)/3 + (MD/H+MD/M+MD/L)/3 (15)

Revised Two-Factor Model – Regression equation 16

$$Rit - Rft = \beta i(Rmt - Rft) + siSMBPMDt + \varepsilon it \quad (16)$$

The descriptive statistics for the nine portfolios did not change from the first test of the research question. The only change in the data was for the revised size factor (SMBPMD) and there were noticeable extreme changes for the three periods.

Table 36

Descriptive Statistics - 9 Portfolios Revised Two-Factor Model

	2015 - 2006			2015 - 2011			2010 - 2006		
Variable	Mean	Std. Deviation	N	Mean	Std. Deviation	N	Mean	Std. Deviation	N
R2000V	.0002348	.01705167	2517	.0002911	.01263036	1258	.0001785	.02054540	1259
R2000	.0003020	.01661967	2517	.0003800	.01304287	1258	.0002240	.01955591	1259
R2000G	.0003701	.01644921	2517	.0004701	.01368712	1258	.0002701	.01881343	1259
MidV	.0002629	.01461024	2517	.0003917	.01048830	1258	.0001342	.01780360	1259
Mid	.0002996	.01438746	2517	.0004228	.01067542	1258	.0001764	.01732321	1259
MidG	.0003306	.01444146	2517	.0004531	.01106011	1258	.0002082	.01717127	1259
T200V	.0001628	.01398799	2517	.0003717	.00995182	1258	-.0000459	.01709621	1259
T200	.0002259	.01279507	2517	.0004393	.00959707	1258	.0000126	.01533969	1259
T200G	.0002934	.01204262	2517	.0005080	.00955482	1258	.0000790	.01409736	1259
N_Mrkt_RF	.0002481	.01334574	2517	.0004283	.01002502	1258	.0000680	.01599160	1259
SMBPMD	.0004169	.01893241	2517	.0003636	.01474022	1258	.0004701	.02235543	1259

The model summary in Table 37, provides the R, R^2 and adjusted R^2 for the new market premium factor (N_Mrk_RF) and based on the hierarchy order the revised size factor (SMBPMD) was added to the model. The adjusted R^2 was high in most cases and was greater than .9 or 144 cases out of 162. The Russell Top 200 portfolio had an adjusted R^2 was 1.0, and would mean that the two variables perfectly explained the variance of the dependent variable. A high adjusted R^2 was expected based on the sample tested in relation to the construction of the variables in the revised two-factor model but not to the extent of the results of the model summary. The Durbin-Watson statistic average was 2.001, with a low of 1.949 and high of 2.169 and no indication of autocorrelation or non-randomness that could arise through independent errors.

Table 37

Adjusted R² - 9 Portfolios Revised Two-Factor Model

	2015- 2006			2015- 2011			2010 - 2006		
Portfolios	R	R²	Adj. R²	R	R²	Adj. R²	R	R²	Adj. R²
R2000V									
N_Mrkt_RF	0.938	0.879	0.879	0.936	0.875	0.875	0.938	0.881	0.881
N_Mrkt_RF, SMBPMD	0.984	0.967	0.967	0.982	0.964	0.964	0.985	0.970	0.970
R2000									
N_Mrkt_RF	0.945	0.893	0.893	0.942	0.887	0.887	0.947	0.897	0.897
N_Mrkt_RF, SMBPMD	0.993	0.987	0.987	0.993	0.987	0.987	0.994	0.987	0.987
R2000G									
N_Mrkt_RF	0.937	0.878	0.878	0.931	0.866	0.866	0.943	0.889	0.889
N_Mrkt_RF, SMBPMD	0.987	0.974	0.974	0.986	0.973	0.973	0.989	0.978	0.978
MidV									
N_Mrkt_RF	0.981	0.962	0.962	0.980	0.960	0.960	0.981	0.963	0.963
N_Mrkt_RF, SMBPMD	0.986	0.973	0.973	0.985	0.970	0.969	0.988	0.975	0.975
Mid									
N_Mrkt_RF	0.988	0.976	0.976	0.987	0.974	0.974	0.988	0.977	0.977
N_Mrkt_RF, SMBPMD	0.994	0.989	0.989	0.994	0.988	0.988	0.995	0.989	0.989
MidG									
N_Mrkt_RF	0.977	0.954	0.954	0.975	0.951	0.951	0.977	0.955	0.955
N_Mrkt_RF, SMBPMD	0.984	0.968	0.968	0.984	0.969	0.969	0.984	0.968	0.968
T200V									
N_Mrkt_RF	0.980	0.961	0.961	0.978	0.957	0.957	0.982	0.963	0.963
N_Mrkt_RF, SMBPMD	0.986	0.972	0.972	0.984	0.968	0.968	0.987	0.974	0.974
T200									
N_Mrkt_RF	0.995	0.989	0.989	0.994	0.987	0.987	0.995	0.990	0.990
N_Mrkt_RF, SMBPMD	1.000	0.999	0.999	0.999	0.999	0.999	1.000	0.999	0.999
T200G									
N_Mrkt_RF	0.979	0.958	0.958	0.977	0.955	0.955	0.980	0.961	0.961
N_Mrkt_RF, SMBPMD	0.983	0.966	0.966	0.983	0.967	0.967	0.984	0.968	0.968

The ANOVA analysis for the nine Russell indexes for the three periods was presented in Table 38. The F-ratio was significant or where $P < .001$ for all time periods and portfolios, and indicated all the models improved the predictability of the outcome and the variance in excess returns of the Russell portfolios.

Table 38

ANOVA Analysis - 9 Portfolios Revised Two-Factor Model

	2015 - 2006		2015 - 2011		2010 - 2006	
	F	Sig.	F	Sig.	F	Sig.
R2000V						
N_Mrkt_RF	18,270	0.00	8,810	0.00	9,277	0.00
N_Mrkt_RF, SMBPMD	37,220	0.00	16,758	0.00	20,037	0.00
R2000						
N_Mrkt_RF	21,048	0.00	9,822	0.00	10,965	0.00
N_Mrkt_RF, SMBPMD	254,020	0.00	149,107	0.00	121,428	0.00
R2000G						
N_Mrkt_RF	18,045	0.00	8,107	0.00	10,095	0.00
N_Mrkt_RF, SMBPMD	46,432	0.00	22,555	0.00	28,007	0.00
MidV						
N_Mrkt_RF	63,014	0.00	30,172	0.00	32,929	0.00
N_Mrkt_RF, SMBPMD	44,776	0.00	19,960	0.00	24,906	0.00
Mid						
N_Mrkt_RF	102,216	0.00	47,325	0.00	52,938	0.00
N_Mrkt_RF, SMBPMD	109,800	0.00	50,886	0.00	57,761	0.00
MidG						
N_Mrkt_RF	52,256	0.00	24,536	0.00	26,947	0.00
N_Mrkt_RF, SMBPMD	38,049	0.00	19,657	0.00	18,814	0.00
T200V						
N_Mrkt_RF	61,493	0.00	28,047	0.00	33,102	0.00
N_Mrkt_RF, SMBPMD	43,240	0.00	19,155	0.00	23,675	0.00
T200						
N_Mrkt_RF	234,177	0.00	96,492	0.00	127,775	0.00
N_Mrkt_RF, SMBPMD	1,372,845	0.00	541,501	0.00	774,703	0.00
T200G						
N_Mrkt_RF	57,643	0.00	26,844	0.00	31,119	0.00
N_Mrkt_RF, SMBPMD	35,588	0.00	18,273	0.00	18,780	0.00

The revised two-factor coefficients *b*-values and *t*-tests were presented in Table 39 for the nine portfolios over the three periods. For all the portfolios and time periods, the *t*-tests had $p < .001$, and meant all the predictor variables were significant and affected the excess returns of the three portfolios. The Russell 2000 value, Russell 2000, and Russell growth coefficients for both variables (market premium and size) were fairly consistent for the three periods. The other portfolios, Russell Mid Cap and Russell Top 200 group of portfolios, the *b*-values for the market premium variable (N_Mrkt_RF) were fairly consistent for the three periods. This was not true for the size variable (SMBPMD), and the positive *b*-values were extremely low and ranged from .12 to a high of .21 for the Russell Mid Cap portfolio. The negative *b*-values for the Russell Top 200 portfolio were extremely low and ranged from -.19 to a high of -.012. Even though the *b*-values were not 0, no relationship to the dependent variable, the low coefficients indicated that the relationship of the size variable was very minimal and could not be a viable factor.

Table 39

Coefficients - 9 Portfolios Revised Two-Factor Model

	2015 - 2006				2015 - 2011				2010 - 2006			
	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
R2000V												
N_Mrkt_RF	0.38	0.011	34.654	0.000	0.40	0.016	25.823	0.000	0.36	0.015	23.747	0.000
SMBPMD	0.64	0.008	82.447	0.000	0.59	0.011	55.529	0.000	0.66	0.011	60.631	0.000
R2000												
N_Mrkt_RF	0.36	0.007	52.633	0.000	0.37	0.010	38.195	0.000	0.35	0.009	37.233	0.000
SMBPMD	0.64	0.005	134.060	0.000	0.64	0.007	97.085	0.000	0.63	0.007	94.153	0.000
R2000G												
N_Mrkt_RF	0.33	0.009	34.966	0.000	0.34	0.015	23.644	0.000	0.34	0.012	28.459	0.000
SMBPMD	0.64	0.007	95.670	0.000	0.70	0.010	70.459	0.000	0.61	0.008	71.313	0.000
MidV												
N_Mrkt_RF	0.83	0.009	96.246	0.000	0.81	0.012	68.629	0.000	0.82	0.012	69.073	0.000
SMBPMD	0.19	0.006	31.929	0.000	0.16	0.008	19.762	0.000	0.21	0.009	24.935	0.000
Mid												
N_Mrkt_RF	0.80	0.005	147.759	0.000	0.79	0.008	103.912	0.000	0.80	0.008	105.057	0.000
SMBPMD	0.20	0.004	53.102	0.000	0.19	0.005	37.532	0.000	0.21	0.005	38.113	0.000
MidG												
N_Mrkt_RF	0.78	0.009	85.218	0.000	0.77	0.013	61.221	0.000	0.79	0.013	59.874	0.000
SMBPMD	0.21	0.006	33.101	0.000	0.23	0.009	26.844	0.000	0.21	0.009	21.839	0.000
T200V												
N_Mrkt_RF	1.26	0.008	151.483	0.000	1.19	0.011	103.499	0.000	1.29	0.012	110.347	0.000
SMBPMD	-0.18	0.006	-31.349	0.000	-0.16	0.008	-20.995	0.000	-0.19	0.008	-22.853	0.000
T200												
N_Mrkt_RF	1.16	0.001	842.091	0.000	1.17	0.002	551.119	0.000	1.15	0.002	619.894	0.000
SMBPMD	-0.16	0.001	-163.363	0.000	-0.16	0.001	-112.592	0.000	-0.16	0.001	-117.687	0.000
T200G												
N_Mrkt_RF	1.05	0.008	133.416	0.000	1.14	0.011	101.379	0.000	1.02	0.011	94.348	0.000
SMBPMD	-0.13	0.006	-23.806	0.000	-0.16	0.008	-20.847	0.000	-0.12	0.008	-15.843	0.000

The correlation matrix for the revised two-factor model was presented in Table 40, and there were no negative correlations between variables. However, there was a very high correlation between all the variables magnitude of the correlation was very high and the majority of the cases were greater than $r > .9$. A high correlation was expected because of the construction of the independent variables (size and market premium) that were based on the sample population or the dependent variables but not to the extent of the results and could be an indication of multicollinearity.

Table 40

Correlations - 9 Portfolios Revised Two-Factor Model

Pearson Correlation	2015 - 2006	2015 - 2011	2010 - 2006
	SMMDMB	SMMDMB	SMMDMB
R2000V	.976	.972	.978
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
R2000	.986	.985	.986
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
R2000G	.980	.980	.982
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
MidV	.934	.925	.939
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000

	SMMDMB	SMMDMB	SMMDMB
Mid	.944	.940	.946
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
MidG	.936	.936	.936
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
T200V	.845	.835	.851
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
	.861	.848	.867
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000
	SMMDMB	SMMDMB	SMMDMB
T200G	.851	.834	.859
N_Mrkt_RF	.907	.901	.910
SMBPMD	1.000	1.000	1.000

The VIF statistics, presented in Table 41, was as low of 1.000 and the highest of 5.840 and this did not show any concern of collinearity but some bias in the variables. The VIF values were not below 0.2 or greater than 10. Otherwise it would be a cause of concern of collinearity.

Table 41

Collinearity Statistics - Tolerance and VIF Revised Two-Factor Model

		2015 - 2006		2015 - 2011		2010 - 2006	
Model		Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
Model 1 - 1 Variable	N_Mrkt_RF	1.000	1.000	1.000	1.000	1.000	1.000
Model 2 - 2 Variables	N_Mrkt_RF	0.177	5.647	0.189	5.292	0.171	5.840
	SMBPMD	0.177	5.647	0.189	5.292	0.171	5.840

In the casewise diagnostic Table 42, the majority of the cases fell beyond the acceptable range, and of the 27 cases, 18 cases fell outside the range of acceptability that was a result of extreme outliers or 2 standard deviations from the mean. This was compared to the FF model that had 14 cases that fell outside the range with the majority of the cases during the period of the financial crisis of 2008.

Table 42

Summary of Casewise Diagnostics greater than - 2 and + 2

	2015 - 2006		2015 - 2011		2010 - 2006	
Total Cases	2517		1258		1259	
Acceptable level of Cases	126		63		63	
Model	2-Factors	FF model	2-Factors	FF model	2-Factors	FF model
R2000V	129	123	62	64	73	65
R2000	116	123	63	65	65	67
R2000G	134	115	69	60	71	71
MidV	127	118	61	63	66	63
Mid	122	129	65	56	58	67
MidG	128	135	65	60	70	74
T200V	130	120	60	64	70	71
T200	131	123	59	57	59	67
T200G	128	133	64	62	68	71

The revised two-factor model provided results for the size factor and was not negatively correlated with the other variables. However, there were issues regarding the high adjusted R^2 and high correlations between variables. This could be a case of multicollinearity between the variables and was indicated by the high number of cases, and though the range of the VIF statistic level was not beyond the range of .2 and 10 it was much greater than 1 which did show bias, but some bias was expected because of the construction of the variables. This required further tests and used dependent variables that were a much smaller sample of the population of the U.S. financial market or individual stocks. The revised two-factor model was tested and used the individual stocks tested in research question one to determine the rigor of the model with a smaller sample of the population and if collinearity existed. Also, the results of the revised two-factor model were compared to the results of the FF model tested in the first research question for comparison purposes for internal validity and also if the new model was better than the current existing three factor model.

The descriptive statistics were the same for the individual stocks as in the results for research question one and was presented in Table 8 – 10. The only change in the descriptive statistics were the results of the revised two-factor model and was presented in Table 43 along with the results for the FF model. The means were greater for the new size factor (SMBPMD), and the difference was expected since there was the addition of the returns of the midsize portfolio in the construction of the new factor. The new market premium (N_Mrkt_RF) was less than the variable in the FF model, and this could be that that the new market premium was based on the Russell 3000 portfolio.

Table 43

Descriptive Statistics - Factors for Revised Two-Factor Model

	2015 - 2006			2015 - 2011			2010 - 2006		
Stock	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Revised Two-Factor Model									
SMBPMD	0.00042	0.01893	2,517	0.00036	0.01474	1,258	0.00047	0.02236	1,259
N_Mrkt_RF	0.00025	0.01335	2,517	0.00043	0.01003	1,258	0.00007	0.01599	1,259
FF Model									
SMB	0.00004	0.00593	2,517	- 0.00007	0.00517	1,258	0.00014	0.00661	1,259
HML	- 0.00004	0.00692	2,517	- 0.00008	0.00436	1,258	0.00000	0.00876	1,259
MRK_RF	0.00033	0.01310	2,517	0.00050	0.01002	1,258	0.00015	0.01558	1,259

The adjusted R^2 results for the revised two-factor model was very similar to the FF model (Table 44). The FF model's adjusted R^2 was slightly higher than the revised two-factor model, meaning that the FF model explained the variation of the dependent variable slightly better. Only a few cases were the difference significant, and the highest difference was National Penn Bancshares where it was 19% higher. The FF model did contain a third factor, the value factor (HML), and added to the model could explain the dependent variable or the excess returns better than a two-factor model. The results also confirm that the high adjusted R^2 when the nine portfolios were tested was based on the dependent variable, construction of the portfolios, as a large representative (number of stocks) sample of the population that was being tested would result in a higher adjusted R^2. The Durbin-Watson statistic average was 2.044, with a low of 1.816 and high of 2.484 and no indication of autocorrelation or non-randomness that could arise through independent errors.

Table 44

Model Summary - Adjusted R^2 - Revised Two-Factor Model

Model Summary	2015 - 2006 Adjusted R Square	2015 - 2011 Adjusted R Square	2010 - 2006 Adjusted R Square
3M Company			
Two-Factor Model	0.603	0.664	0.580
FF Model	0.603	0.661	0.579
Allstate Corporation			
Two-Factor Model	0.529	0.519	0.544
FF Model	0.585	0.568	0.592
Prudential Financial, Inc.			
Two-Factor Model	0.545	0.675	0.533
FF Model	0.640	0.732	0.634
IBM			
Two-Factor Model	0.509	0.441	0.559
FF Model	0.512	0.430	0.567
Occidental Petroleum Corp.			
Two-Factor Model	0.462	0.530	0.446
FF Model	0.465	0.548	0.463
IAC Interactive			
Two-Factor Model	0.286	0.262	0.314
FF Model	0.291	0.279	0.313
NetApp, Inc.			
Two-Factor Model	0.381	0.305	0.417
FF Model	0.387	0.308	0.428
Intercontinental Exchange Inc.			
Two-Factor Model	0.384	0.395	0.403
FF Model	0.385	0.397	0.403
Cablevision Systems Corp.			
Two-Factor Model	0.312	0.185	0.394
FF Model	0.315	0.185	0.402
Masco Corp.			

Two-Factor Model	0.491	0.448	0.515
FF Model	0.504	0.440	0.550
National Penn Bancshares, Inc.			
Two-Factor Model	0.053	0.542	0.005
FF Model	0.063	0.633	0.005
Crawford & Company			
Two-Factor Model	0.295	0.322	0.283
FF Model	0.318	0.349	0.306
Snyder's-Lance, Inc.			
Two-Factor Model	0.246	0.331	0.220
FF Model	0.273	0.342	0.251
Gorman-Rupp Company			
Two-Factor Model	0.495	0.483	0.502
FF Model	0.504	0.501	0.507
Universal Technical Institute, Inc.			
Two-Factor Model	0.190	0.191	0.195
FF Model	0.210	0.221	0.208

The *F*-ratio was significant or where $P < .001$ for all time periods and portfolios except for one stock, the National Penn Bancshares. The model was a significant fit to the data. The revised two-factor model had two situations of insignificance while the FF model had 13 cases over 8 different stocks (Table 12), and indicated that the revised two-factor model had a better fit to the data than the FF model for the sample tested.

Table 45

ANOVA (Non-significant) - Revised Two-Factor Model

	2015 - 2006		2015 - 2011		2010 - 2006	
Model Summary	F	Sig.	F	Sig.	F	Sig.
National Penn Bancshares, Inc.						
Model 1: (Constant), SMBPMD	142.9	0.000	1,393.7	0.000	6.9	0.009
Model 2: (Constant), SMBPMD, N_Mrkt_RF	71.6	0.000	743.8	0.000	4.4	0.012

No coefficients or the *b*-values for the revised two-factor modes were 0, but there were some low values and was comparable to the FF model. There were 31 cases and listed in Table 46 where the *t*– test, p > .001 indicating they were not significant and did not affect the dependent variable or the excess returns of the stock. The FF model had 66 cases but had three variables and cannot be used for comparison purposes.

Table 46

Coefficients (t-values, P > .001) - Revised Two-Factor Model

					Coefficients			
Stock	Size	Period	Variable	Model	B	Std.	t	Sig.
3M Company Model	Large	2015 - 2006	SMBPMD	2	-0.062	0.023	-2.735	0.006
3M Company Model	Large	2010 - 2006	SMBPMD	2	-0.046	0.032	-1.435	0.151
Allstate Corporation	Large	2015 - 2006	SMBPMD	2	-0.012	0.038	-0.323	0.747
Allstate Corporation	Large	2015 - 2011	SMBPMD	2	-0.076	0.039	-1.935	0.053
Allstate Corporation	Large	2010 - 2006	SMBPMD	2	0.036	0.059	0.616	0.538
Prudential Financial, Inc.	Large	2015 - 2006	SMBPMD	2	-0.113	0.058	-1.960	0.050
Prudential Financial, Inc.	Large	2015 - 2011	SMBPMD	2	0.029	0.047	0.628	0.530
Prudential Financial, Inc.	Large	2010 - 2006	SMBPMD	2	-0.163	0.093	-1.750	0.080
IBM	Large	2010 - 2006	SMBPMD	2	-0.063	0.031	-2.005	0.045
Occidental Petroleum Corp.	Large	2015 - 2011	SMBPMD	2	0.026	0.052	0.500	0.617
IAC Interactive	Mid	2015 - 2011	SMBPMD	2	0.144	0.064	2.240	0.025
NetApp, Inc.	Mid	2015 - 2011	SMBPMD	2	0.103	0.071	1.462	0.144
Intercontinental Exchange Inc.	Mid	2015 - 2006	SMBPMD	2	0.032	0.061	0.520	0.603
Intercontinental Exchange Inc.	Mid	2015 - 2011	SMBPMD	2	-0.007	0.051	-0.146	0.884
Intercontinental Exchange Inc.	Mid	2010 - 2006	SMBPMD	2	0.076	0.097	0.784	0.433
Cablevision Systems Corp.	Mid	2015 - 2006	SMBPMD	2	0.163	0.053	3.057	0.002
Cablevision Systems Corp.	Mid	2015 - 2011	SMBPMD	2	0.071	0.09	0.793	0.428
Cablevision Systems Corp.	Mid	2010 - 2006	SMBPMD	2	0.211	0.067	3.128	0.002
National Penn Bancshares, Inc.	Small	2015 - 2006	N_Mrkt_RF	2	-0.062	0.101	-0.618	0.536
National Penn Bancshares, Inc.	Small	2010 - 2006	SMBPMD	1	0.122	0.047	2.625	0.009
National Penn Bancshares, Inc.	Small	2010 - 2006	SMBPMD	2	0.267	0.113	2.370	0.018
National Penn Bancshares, Inc.	Small	2010 - 2006	SMBPMD	2	-0.222	0.157	-1.410	0.159
Crawford & Company	Small	2015 - 2006	N_Mrkt_RF	2	0.162	0.126	1.289	0.197
Crawford & Company	Small	2015 - 2011	N_Mrkt_RF	2	0.242	0.178	1.358	0.175
Crawford & Company	Small	2010 - 2006	N_Mrkt_RF	2	0.142	0.179	0.792	0.429
Snyder's-Lance, Inc.	Small	2015 - 2006	N_Mrkt_RF	2	0.039	0.064	0.607	0.544
Snyder's-Lance, Inc.	Small	2010 - 2006	N_Mrkt_RF	2	-0.135	0.092	-1.462	0.144
Gorman-Rupp Company	Small	2015 - 2011	N_Mrkt_RF	2	0.258	0.12	2.154	0.031
Universal Technical Institute, Inc.	Small	2015 - 2011	N_Mrkt_RF	2	-0.008	0.094	-0.085	0.932
Universal Technical Institute, Inc.	Small	2010 - 2006	N_Mrkt_RF	2	-0.014	0.162	-0.084	0.933
Universal Technical Institute, Inc.	Small	2015 - 2006	N_Mrkt_RF	2	0.028	0.117	0.234	0.815

Model 1: (Constant), SMBPMD
Model 2: (Constant), SMBPMD, N_Mrkt_RF

The correlation matrix for the revised two-factor model was presented in Table 47, and there were no negative correlations between variables. The correlations between the independent and dependent variable were high but not over *r* > .9. However, there was still a very high correlation between the independent variables with a high of .910 or slightly over the *r* > .9 guideline. The size variable was constructed based on a large portion of the population or the U.S. financial market represented by the market premium variable, and a high correlation was expected. In comparison to the FF model, the correlation was not as high but it also contained another variable, value (HML), and also midsize portfolios were not included in the size factor (SMB).

Table 47

Correlations - Revised Two-Factor Model

Pearson Correlation	2015 - 2006	2015 - 2011	2010 - 2006
	SMBPMD	SMBPMD	SMBPMD
MMM	.690	.707	.683
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
Al	.658	.632	.677
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
PRU	.659	.744	.650
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
IBM	.610	.510	.665

SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
OXY	.582	.660	.557
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
IAC	.513	.483	.542
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
NTAP	.583	.512	.614
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
ICE	.566	.566	.585
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
CVC	.526	.397	.597
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
MAS	.690	.647	.711
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
NPBC	.232	.725	.074
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
CRD.B	.543	.568	.533
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD

LNCE	.497	.562	.469
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
GRC	.699	.694	.702
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910
	SMBPMD	SMBPMD	SMBPMD
UTI	.436	.438	.443
SMBPMD	1.000	1.000	1.000
N_Mrkt_RF	.907	.901	.910

The VIF statistics, presented in Table 48, was as low of 1.000 and the highest of 5.8405 and did not show any concern of collinearity but there was some bias. The VIF values were not below 0.2 or greater than 10. Otherwise it would be a cause of concern of collinearity. The range of the statistic was much greater than then for the FF model which was a low of .734 and the highest of 1.362.

Table 48

Collinearity Statistics - Tolerance and VIF - Revised Two-Factor Model

	2015 - 2006		2015 - 2011		2010 - 2006	
Model	Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
(Constant)	1.000	1.000	1.000	1.000	1.000	1.000
SMBPMD	0.1771	5.6470	0.1890	5.2921	0.1712	5.8405
N_Mrkt_RF	0.1771	5.6470	0.1890	5.2921	0.1712	5.8405

The casewise diagnostics of the revised two-factor model produced 7 cases over the acceptable level of 2 standard deviations from the mean or extreme outliers and was comparable to the FF model that had 6 cases over the acceptable level. Based on the results and comparison to the results of the FF model, there was not a concern of collinearity and extreme outliers in the revised two-factor model.

Table 49

Summary of Casewise Diagnostics greater than - 2 and + 2 - Revised Two-Factor Model

	2015 - 2006	2015 - 2011	2010 - 2006
Total Cases	2517	1258	1259
Acceptable level of Cases greater than -2 and +2	126	63	63
3M Company	96	54	54
Allstate Corporation	109	46	59
Prudential Financial, Inc.	99	51	65
IBM	118	43	63
Occidental Petroleum Corporation	87	60	33
IAC Interactive	112	55	53
NetApp, Inc.	116	55	59
Intercontinental Exchange Inc.	119	70	58
Cablevision Systems Corp.	99	41	56
Masco Corp.	126	54	63
National Penn Bancshares, Inc.	130	51	67
Crawford & Company	141	64	64
Snyder's-Lance, Inc.	89	54	38
Gorman-Rupp Company	93	50	53
Universal Technical Institute, Inc.	97	45	53

The results of the statistical tests for the revised two-factor model for the sample of 15 individual stocks confirmed that the model was a significant predictor of returns of individual stocks. The purpose of these tests were issues of high correlations and other results that indicated there could be high collinearity when the nine portfolios were tested. There still were high correlations between independent variables (size and market premium) but was expected because of the construction of the variables and the highest correlation was slightly greater than $r > .9$ or .910. The correlations between the dependent and independent variables varied and were all below $r > .9$. Also, the results of the VIF statistic level was not beyond the range of .2 and 10 for the cause of concern of collinearity but was beyond 1 and the highest value of 5.8405 and indicated there was a bias that can be accounted for by the construction of the variables with the use of the Russell indexes. The casewise results were in line with the FF model. From these results, the null hypothesis for both the second and third research question can be rejected based on these additional tests and that the revised two-factor was a significant predictor of financial returns for the three portfolios based on market capitalization as a proxy for size and the nine portfolios grouped on size and B/M that included mid-caps (3x3) in a two-factor model. The results were not conclusive as to which model was better, two-factor model or the FF model.

Validity of Multiple Regression Assumptions

I performed multiple regression analysis for three models and were the FF model, the two-factor model, and a revised two-factor model. The statistical assumptions for the multiple regression analysis were important since I drew conclusions from the population based on the regression analysis of a sample and specifically the fit of the data to the models under investigation (Field, 2013). The first statistical assumption for the multiple regression models were that all the predictor variables or factors were quantitative or categorical (at least 2 categories) and the outcome variable must be quantitative, continuous, and unbounded. This assumption was not violated for all three models since the measure for all the variables were the same and were the returns of a security or portfolio of securities. This included the daily returns of a stock, portfolios of stocks, and the risk-free rate and was quantitative, continuous and unbounded.

The next assumption was that there should be no non-variance values for the predictor variables or factors. This assumption inferred that there was no difference between the predictor variables and if this assumption was violated then it would be better to use the mean to determine the value of a security or portfolio of securities than the proposed models. For the three models, there were no non-variance values and was indicated by the descriptive analysis output that provided the means of the predictive variables.

Another assumption was the significance of the predictor variables or factors in predicting the outcome variable and as indicated by Field (2013) that if there were non-significance, then it would be better to use the means to predict the outcome than the model. From the ANOVA outputs, *b*-values and the *t*-tests were provided to determine the *b*-values and the relationship between the predictor (factor) and the outcome and if non-significant based on the *t*-test where $p > .001$. This indicated that there were no non-significant relationships between the *b*-value and the dependent variable or outcome. For all three models, there was a significant relationship between the *b*-values and the outcome variables based on the *t*-tests for all portfolio datasets. This was not true when the dataset were individual stocks, and for the FF model, there were 39 cases compared to the revised two-factor model there were 30 cases for the complete model out of the 135 tests. These situations where the assumption of non-significance could be explained based on the small size of the sample (one stock) compared to the population. To better determine if this assumption was violated, rather than using the *t*-test, was whether the *b*-value equaled 0, or that there was no relationship and indication of non-linearity or for each case, as follows:

FF model Regression equation: $Rit - Rft = \beta i(Rmt - Rft) + siSMBt + hiHMLt + \varepsilon it,$ where, $\beta_1 = \beta i$, $\beta_2 = si$, and $\beta_3 = hi$:

H_0: $\beta_1 = \beta_2 = \beta_3 = 0$; The model is not valid since all the coefficients are zero.

H_1: not all β are 0; The model is valid since at least one coefficient is not zero.

Two-Factor Model: $Rit - Rft = \beta i(Rmt - Rft) + siSMMDMBt + \varepsilon it,$ where, $\beta_1 = \beta i$, *and* $\beta_2 = si$:

H_0: $\beta_1 = \beta_2 = 0$; The model is not valid since all the coefficients are zero.

H_1: not all β are 0; The model is valid since at least one coefficient is not zero.

Revised Two-Factor Model: $Rit - Rft = \beta i(Rmt - Rft) + siSMBPMDt + \varepsilon it,$ where, $\beta_1 = \beta i$, *and* $\beta_2 = si$:

H_0: $\beta_1 = \beta_2 = 0$; The model is not valid since all the coefficients are zero.

H_1: not all β are 0; The model is valid since at least one coefficient is not zero.

For all three models and tests, individual stocks or portfolios, this assumption was not violated.

An important assumption for multiple regression analysis was that there should be no perfect collinearity or multicollinearity (for more than two factors or predictor variables). To determine if this assumption was violated, a high correlation of $r > .9$ and the variance inflation factor (VIF) was used. For all three models, there was varying high correlations and only one case where $r > .9$ and was for the revised two-factor model for individual stocks for the period of the financial crisis or 2010 – 2006 and was .910 but was not a definitive result to assume collinearity. Another statistical test to better determine if the assumption of no collinearity was violated was the VIF statistic where Field (2013) noted that if VIF statistic was below .2 and greater than 10 there was a concern or problem with collinearity or multicollinearity. None of the VIF statistics for the three models was below .2 or higher than 10 and with the highest VIF statistic of 5.8405 for the revised two-factor model.

The final assumption I looked for was no autocorrelation or non-randomness that can arise through independent errors. The Durbin-Watson statistic was used to determine this assumption and as indicated by Field (2013) that it should not be less than 1 and greater than 3 and Karki, and Ghimire (2016) used a range between 1.5 and 2.5 in their tests. For all the models, the Durbin-Watson statistic was within the range and for the FF model with the highest result, for individual stocks, was 2.497 and for the revised two-factor model was 2.484, also for individual stocks.

Summary

I performed extensive statistical tests on the FF model, two-factor model, and the revised two-factor model with different sample datasets over three-time periods. The first research question examined the tested the FF model with samples of 15 individual stocks based on size (small, mid-cap, and large) over three-time periods to isolate the period of the financial crisis. The null hypothesis, market capitalization as a proxy for size was not a significant predictor of future returns of a stock using the FF model, was rejected. This result was expected since the FF model had been the de-facto or standard multifactor model that has been studied in the academic literature and the results were used to compare the results of the two-factor model.

The next statistical tests I examined was the two-factor model for samples of the three portfolios based on size (small, mid-cap, and big) over the same time periods for all the tests. For the second research question, the null hypothesis that was tested, a two-factor model that used mid-cap portfolio for the size factor did not explain or predict the returns of different sized portfolios (small, mid-cap, and big) accurately, the results indicated that the null hypothesis could not be rejected. This was based on the results that showed a negative relationship of the size factor (SMMDMD) with the other variables and was unexpected, and the third research question would confirm this result was valid. The third research question expanded on the sample that was tested from three size portfolios to include value and growth portfolios for a total of nine portfolios. Again, the Pearson correlation results again showed a negative relationship of the new size factor (SMMDMD) with the other variables in the new added value and growth portfolios. The null hypothesis cannot be rejected based on this negative correlation.

Based on these results, I re-examined of the construction of the size factor (SMMDMB), and additional tests were performed and changed original model to a revised two-factor model with a new size factor (SMBPMD). The revised two-factor was re-tested with the samples of the first and third research questions and were compared to results of the FF model for validation and re-assurance of the results. There were no negative correlations and were consistent with the FF model except there was bias in the VIF statistic but were not lower than .2 or higher than 10. Otherwise it would have been serious concern of collinearity. The null hypothesis for both the second and third research question can be rejected for the revised two-factor. The revised two-factor model that included mid-caps for the size factor was a significant predictor of financial returns for three portfolios based on market capitalization as a proxy for size and the nine portfolios grouped by size and B/M.

I presented a more detailed interpretation of the findings in the next chapter. This included the limitations faced in the tests performed and recommendations for further research of the size factor for the second factor in future multifactor models. In addition, I also presented the implications of positive social change and other implications regarding the research and application of multifactor models both for practice and for individual investors.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to determine the viability of a two-factor model that included mid-cap securities in the size factor. The current research in multifactor models focused on one factor and three plus factors but has not examined the second factor or the size factor. The tests I performed were designed to examine and better understand the size factor in multifactor models to produce better valuation tools. The design of the study was based on the empirical nature of the variables in the models or the returns on a security. The design of the study was based on quantitative methods, and the models were tested that used a quasi-experimental design based on time-series experiment over three periods. The research methodologies included data collection and analysis based on studies by Panta, et al., (2016) and Karki and Ghimire (2016). The type of statistical tests that I used were multiple regression and specifically the fit of the data collected to the models and their ability to predict values of the dependent variable (DV) the returns.

The results from the tests provided a better understanding of the size factor and provided an in-depth analysis of a stand-alone two-factor model that has not been fully examined, creating a gap in the current literature. The key finding from the statistical tests for the proposed original stand-alone two-factor model produced results where the size factor was negatively correlated to the market premium and the dependent variable or the excess returns of the 3 portfolios tested in research question two. When I revised the model with a size factor that included small minus big plus mid constructed

(SMBPMD) portfolios, the model explained the returns of the dependent variable significantly.

Interpretation of Findings

Banz (1981) postulated the size effect anomaly where small cap stock returns outperformed large caps and was shown statistically for the years between for the 1936-1977 period and was the basis of the size factor (SMB) for the FF model (Fama & French, 1993). The current standard formula to calculate the size factor was small minus big and for research questions, two and three mid-caps were included to produce a finer examination of the effects of size. The inclusion of mid-caps was based on the fact that there was no definitive or specific research on mid-caps and the effects to returns of a security or a portfolio of securities. Originally, I proposed that mid-caps would underperform small caps and would be more aligned with the returns of large caps. This was based on a past study by De Moor and Sercu (2013), in which the researchers noted that a finer classification of size that used the smallest decile of small caps stocks could provide a better lens of the small size effect and the assumption was made that mid-caps returns would be added to the new factor and was subtracted in the factor or small minus mid-caps minus big caps. The two-factor models that included the new size factor produced results that were not consistent with the results of the tests performed on the FF model, the benchmark to assess the validity of the proposed new model. The results of the statistical tests for the size factor were negatively correlated with the new market premium variable (N_Mrk_RF) and the excess returns of the three portfolios returns. To ensure the validity of the results for research question two, the proposed two-factor model was tested for the other six portfolios for research question three, and the same results occurred. The two-factor model with the originally proposed size factor based on these results would mean the null hypothesis could not be rejected and the two-factor model was not a viable multifactor model.

The findings from research question two and three resulted in a re-evaluation of the size factor and a revised two-factor model were re-tested. I revised the two-factor model to include a new size factor where the mid-cap portfolio was added instead of minus to determine the size factor and was small minus big plus mid-caps (SMBPMD). The revised two-factor with a new size factor was not made arbitrarily but was based on the academic literature and some additional tests. As already stated, the size effect was where small sized stocks outperform large sized stocks; the issue was where the mid-caps inclusion in the new size factor portfolio. Mid-caps were included with the assumption the pattern of returns would be based on the formula of the book-to-market sorting procedure, however, for the Russell Growth and Value indices, were constructed using price-to-book ratio, or the opposite of the book-to-market variable required in the 3x3 sort in the size factor. Therefore, the results of the original size factor (SMMDMB) was changed to the revised new size factor of (SMBPMD).

To ensure this conclusion was correct, I performed additional tests to ensure the change to the size factor and the inclusion of mid-caps for the revised two-factor model was acceptable. The proposed size factor formula included a calculation with three terms, where each term could be either positive or negative for a total of eight variations to the size factor. I tested seven variants for the excess returns of one portfolio, Russell Midcaps, over the entire period of tests performed, 2015-2006. The statistical results for *t*-tests found six of the variants, not including the SMMDMB and SMBPMD, were not significant or $p > .001$ (Table 50). This confirmed the use of the new size factor in a revised two-factor model over the other variants of the size factor.

Table 50

Additional Tests - Size Factor

		Coefficients			
Size Factor Acronym	Formula	B	Std. Error	t	Sig.
Two-Factor Model					
SMMDMB	S-M-B	0.095	0.008	12.393	0.000
Revised Two-Factor Model					
SMBPMD	S-B+M	0.203	0.004	53.102	0.000
Other Variants					
SPMDPB	S+M+B	0.000	0.001	-0.400	0.689
SMMDPB	S-M+B	-0.001	0.003	-0.397	0.692
NSMMDMB	-S-M-B	0.000	0.001	0.400	0.689
BMSMMD	B-S-M	0.000	0.002	0.059	0.953
BMSMPMD	B-S+M	-0.003	0.003	-0.805	0.421
MDMSMB	M-S-B	0.001	0.003	0.397	0.692

The additional tests did not produce results to make any generalizations or confirmation of the size effect anomaly. This would require more detailed and rigorous tests and analysis and was not the purpose of this research. The additional tests only provided a viable size factor that could be tested for a revised two-factor model.

I tested individual stocks purposefully as part of the investigation since most of the current major studies tested mainly portfolios. Researchers in past studies used portfolios of stocks with some very small portfolios, and a few did use individual stocks like a study by Sattar (2017) in which the researcher examined five firms in the cement industry on the Dhaka Stock Exchange. I used individual stocks to provide a more rigorous test for the models and provided results that would not otherwise be evident when testing portfolios. Individual investors were another consideration for testing individual stocks and were based on the social equity component of the study. Individual investors require tools to analyze individual stocks to make optimal financial decisions especially since they could only have the financial resources. Individual stocks present idiosyncratic risks that were firm specific and were the unsystematic risk particular to a single asset. The finding of the tests revealed that the financial crisis in 2008 affected the results of particular assets and particularly large sized capitalized stocks. Another finding was that there were F-ratios and t-tests that were nonsignificant ($p > .001$) and had low adjusted R^2 that indicated that both the FF model and the revised two-factor models were not a good fit for the data in all cases where in the tests of portfolios there were no F-ratios or t-tests that were not insignificant.

I did not test portfolios constructed by industry or sector that was common practice by past researchers. Like the study by Sanusi and Ahmad (2016) where they focused their examination on oil and gas companies or Sattar (2017) that examined stocks in the cement industry. The inclusion of sector or industry portfolios could provide important insights into better testing of multifactor models for future research. Portfolios constructed by sector or industry could provide a more robust test of models would not be so rigorous as individual stocks and general when large samples of the population were used with portfolios based on size and value.

Another observation from the use of individual stocks for the statistical testing was that the size of a stock was not consistent over time. The size of some stocks was observed to change over time when each stock was randomly selected and cross-checked to make sure that they were the same size for each period that was tested. Random selection of individual stocks required nine iterations for the small sized stocks before the five stocks could be selected for the sample. This was not a confirmation or generalization of changing of the size classification, but an observation of the sample selection process.

The final results of the statistical tests were that the revised two-factor model was a significant predictor of financial returns for portfolios of stocks based on size and B/M. This finding had some results that had some issues of high correlations and collinearity. There were high correlations between variables and one situation where it was slightly over the $r > .9$ at .910. Another result that was questionable was the VIF statistic of 5.8405 which indicated bias based on the guidelines from Field (2013). Both these results were indications there could be some collinearity or non-linearity. The highest VIF statistic by Shalaei and Hashemi (2017) was 1.403 for tests on portfolios of 88 stocks, and they also reaffirmed this was below the acceptable level of 10. In another study by Foye, Mramor, and Pahor (2016), the highest VIF statistic was 1.13 for portfolios of stocks of Eastern European (EE) countries that joined the European Union (EU) in 2004 and 1.357 for the study by Trinh, Karki, and Ghimire (2016), for portfolios tested in the United Kingdom. In comparison to the FF model, the VIF statistic was much higher and could be due to the use of Russell indexes for the variables instead of construction of the variables using data from primary sources.

There were valid concerns, like collinearity, for the revised two-factor model, but from all the statistical tests the model still was a significant predictor of returns of the samples tested in the research. However, in comparison to the FF model, which was the standard model for multifactor models, there was no conclusive evidence it was a better model. The FF model did perform slightly better than the revised two-factor model in some of the tests and had better VIF statistics, but no conclusive evidence resulted in which a generalization could be made as to which was the better model.

Limitations of the Study

The limitations of the research were based on the variables or factors of the multifactor models that were tested. All the variables, independent or dependent, were based on the returns of a security, stock or T-bill, or portfolio of securities, stocks. Stock returns have firm-specific risks that include firm, industry, and market risks, and were specifically tested in research question one with the 15 individual stocks. Firm-specific risks included the life cycle of a firm (Hanks, 2015) or when a firm goes through the growth and mature phases and affects their market capitalization. In research question one this was accounted for by reviewing the models' performance by stocks chosen based on their size relative to other firms listed on public exchanges and over three periods. This provided an understanding of the limitations of the industry risks or other idiosyncratic risks that would vary and provide a better understanding the models' performance when tested using portfolios of securities that were the standard samples that were tested in current research. As expected, the models' performance was not as significant when the sample consisted of individual stocks compared to portfolios of stocks.

I established validity through the use of three different time periods the models were tested. Market risks and volatility was the validity concern and specifically the financial crisis during 2008. Three periods were tested to ensure the validity of the results and to isolate the period of the financial crisis. Model performance or issues were observed for large market capitalized stocks between the sub periods. Russell Top 50 index rather than the Russell Top 200 index was used in research question two was for a finer size classification for large sized stocks based on the results of research question one and internal validity of results. The finer size classification did not indicate a validity concern especially for the entire period and for the other tests that were performed.

The FF model was not only tested in research question one but also subsequent tests. The additional tests were purposefully designed and performed to ensure the tests of the two-factor model was consistent with the current recognized standard multifactor the FF model. I compared the results of the tests of the two-factor model to the FF model, and the two-factor model was revised based on the results. This ensured the trustworthiness of the results and allowed generalization of how multifactor models should perform.

The main delimitation of the study was the ability to obtain the necessary samples and data to perform tests on portfolios and construct the two-factor model. This was a serious concern because of the accessibility and cost of obtaining the financial information available to other researchers. The lack of accessibility and prohibitive costs were overcome by the use of the data publicly available data from the Kenneth R. French database and the use of the Russell indexes. This required cleaning the datasets from the Russell indexes since they provided the daily returns but the dates were not the same as the data retrieved from other publicly available information like Kenneth R. French database, Yahoo Finance, and Google Finance. The sorting methodology for the construction of the size factor, careful consideration was used to produce a 3x3 sort, three sizes (small, mid-cap, and big) by three B/M classifications (low, mid, and high), to include mid-caps which was different to the current methodology of 2x3 sorts, two size sizes (small and big) by three B/M classifications (low, mid, and high). The portfolios for the 3x3 sorting methodology and samples were done by the use of growth and value Russell indexes that provided the same characteristics of the constructed portfolios used in the FF model.

Recommendations

The results and findings of the study illuminated a number of topics that could be used in future research. The test results of the samples of individual stocks provided insights on how multifactor models performed when the sample was one stock out of many stocks of a population or stock exchange. The idiosyncratic risk of individual stocks provided a stringent measure of the performance of a model, and I recommend for any future research on multifactor models to include tests for individual stocks.

To provide robustness in future tests, portfolios based on sector or industry stocks should also be tested. Individual stocks allow for rigorous tests and portfolios based on size and value provide a general understanding of model performance, but sector and industry would provide robustness in the testing between the two extremes. In addition, the use of sector or industry portfolios would provide a better understanding of models in relation to the functioning of financial markets from a different lens. Finally, the inclusion of sector and industry portfolios would provide investors tools to construct portfolios that extensively used in their investment decisions.

Another topic that became apparent from the study was that the size classification of a stock or stocks in a portfolio were not static but dynamic. In the current literature, most studies focused on whether or not the specific stock in a portfolio or market that was tested met minimum requirements. Das and Barai (2016) included a minimum requirement in their study a survivorship bias or whether the stock had continuous returns in the past 24 months. For other studies, this was done by the size classification, if they were either small or large sized for a given period. However, when dealing with greater than two size classification, there could be dynamics how stocks move from one size classification to another or were delisted. Many financial products and indexes have processes where stocks were added or removed, and for the Russell indexes (2017) it was referred to as reconstitution. Reconstitution and survivorship bias were the methodologies to address the volatility of individual stock market capitalization or when the increase or decrease in value. Currently, there were tools like volatility indexes for financial markets, and specifically for the U.S. financial markets, there was the VIX index that provided a forward-looking measure based on volatility (Bongiovanni, De Vincentiis, & Isaia, 2016). Further research on size dynamics of a sample (stocks) within a population (financial markets) could be an area for future research to better understand particular size dynamics within a portfolio or stock market and also to compare to other markets.

The hierarchical regression method was what I used in the statistical tests for the three research. The sequential ordering of the variables in the models affected the results as indicated from the original results for research question three. As a result, I changed the order to include the new size factor after the new market premium and the results provided some very small adjusted R^2. Consequently, to determine the findings were true the hierarchical order was then reversed, and the results were entirely different. In future research, sequential ordering of variables must be carefully examined, and a stepwise methodology could be appropriate. This statistical methodology was used by Taha and

Elgiziry (2016) and employed a forward stepwise procedure. Each factor was added one at a time and check the significance of the estimated coefficients and the change in the adjusted R^2.

The Durbin-Watson statistic provided a consistent statistical result for all the research questions and models. Field (2013) noted that, as a conservative rule, that it should not be less than 1 and greater than 3 and Karki, and Ghimire (2016) used a range between 1.5 and 2.5 in their tests. The results met both assumptions with results that ranged from a low of 1.804 and 2.497, or within the range of no independent errors. The statistic also provided an indication of no autocorrelation or non-randomness. The results were consistent with the random walk theory where a stock price change from one period to another period and the change was independent of each observation and should have the same probability distribution and was also consistent with EMH.

The random walk and the EMH were important theories of the proper functioning of financial markets. Extreme market movements, I addressed by performing statistical tests for three specific periods to determine the effects of the financial crisis of 2008. The break points for the three periods for the statistical tests were based on the VIX. The casewise diagnostic was another statistical measure that examined extreme outliers or data that does not fit the model. Research studies in other fields of study used casewise diagnostic statistic to determine incorrect data or data that can be removed to produce better models (Ploughman, Collins, Wallack, Monks, & Couldo, 2016). For the tests performed on multifactor models in this study, the data collected were verifiable and from secondary sources and the results could also be an indication of extreme cases because of the financial crisis of 2008 or the idiosyncratic risks of individual stocks. Both the Durbin-Watson statistic and the casewise diagnostics can be an opportunity for further research. The individual unacceptable or extreme cases could be an area that should be reviewed in more detail and improve the model in future research. This could require performing isolated regression analysis for periods that these cases occurred or determining if it was for specific firms or firms in specific industries.

The size effect anomaly that was observed by past researchers (Banz, 1958) asserted small caps outperform large caps but ignored comparison or the relative performance of small and large cap stocks to mid-caps. The size factor in the current standard researched multifactor model, FF model, constructed the size factor with 2x3 sort methodology. This required first a sort of two size sizes (small and big) and then by three B/M classifications (low, mid, and high) to construct six portfolios for the size factor (Dhaoui, & Bensalah, 2017). This assumed that certain stocks within the size classification, small and large, exhibit certain characteristics based on value and the additional sort were added to provide a finer explanation of returns. The additional sort assumed that value stocks (high B/M ratio) tended to outperform growth stocks (low B/M ratio). The model I tested, the two-factor model, included an additional size classification, mid-caps, and the new size factor was now small sized stocks minus midsized minus large sized stock based on a 3x3 sort first by size then by book-to-market low, mid, and high. The original new size factor theorized and was constructed in the original two-factor model was erroneously designed to subtract midsize stocks to produce a finer size classification based on the Russell indices that were constructed a price-to-book ratio or the opposite to the book-to-market ratio in the standard construction of the size factor. Original tests proved the original size factor construction was incorrect in the original two-factor model tested and was attributed to the characteristics of mid-caps to that of large sized stocks and should have been added in the factor based on the calculation of value. In future research, mid-caps should be added based on the determination of value or whether it was price-to-book or subtracted if it was the book-to-market calculation of value.

I found from the statistical tests performed only confirmed that the revised two-factor model with a size factor that included mid-caps that used a 3x3 sort was a viable model. It did not provide evidence that it was a better model than the current FF model or that the new size factor methodologies, 3x3 sort, had greater explanatory power than the original methodology of the size factor that used only a 2x3 sort. It did, however, provide reasonable grounds that future investigation of how the size classification should be constructed and that there needs to better understanding of small, mid-cap, and large classifications. This does not rule out the 2x3 sort but rather how the small and big were determined through the percentiles used in the sort and also that these attributes changed over time.

In determining the original error in the two-factor model, I subtracted the mid-caps in the size factor, another theoretical concern arose. The size effect anomaly had been expressed as small caps outperform large caps and this by the nature of the wording led researchers to focus on small caps. Another way to examine this phenomenon for future research could be to review this anomaly from the large sized perspective and to determine a better classification of the attributes of large caps that could produce a better size factor to be used in multifactor models.

An important assumption of the size factor was that the book-to-market ratio (B/M) does affect the value of stock or firm. This was contrary to the existing Modigliani and Miller theory in their Proposition 1 (MM #1) where capital structure did not affect the value of the firm (Modigliani & Miller, 1958) or specifically the book value. There was no tests or review of this assumption, and there could be a need to examine this theory further since current multifactor models assumed that the MM#1 did not hold true since the concept of value and growth was based on book value and was determined by the debt and equity of a firm. Consequently, was especially true for the third factor, value, but was not tested since the focus of the research questions were on the size factor. The value factor and especially the assumptions regarding the book-to-market ratio and capital structure could be an area of further research.

The data I collected and for the construction of the size factor and the samples that were tested were performed with the use of secondary data. There was limited publicly available information to construct the proposed new size factor and samples that included mid-caps. The information that was available would have required extensive time to prepare the data that could be used for the research in a timely manner and for me obtaining the data from reliable providers (CRSP) was cost prohibitive. For the new size factor (SMBPMD) and the sample tested in research question three, the Russell indexes were used and were listed in Table 18 along with their price-to-book ratio (opposite of the book-to-market ratio) as a proxy for the 3x3 sort construction. It was noted that the high VIF statistic that indicated there could be bias in the two-factor model that and could be because of the use of the Russell indexes as a proxy for the actual 3x3 sort. Further research could be done on a two-factor model that included mid-caps in the size factor that used primary data and construction of 3x3 portfolios for the size factor and samples to be tested.

Implications

Fama and French (1970) asserted that financial markets were the medium that allow market participants, individuals or corporations, to make financial transactions based on informational efficiency. Information allows buyers and sellers to determine the value of a security and for financial markets a stock for transactions to occur. There were various degrees of efficiency like weak, semi-strong, and strong forms and can be determined as to the availability, timely disclosure, and correctness of the information. Informational efficiency and financial markets were seriously questioned with the financial crisis of 2008 and were evident with the reactions by protestors with the Occupy Wall Street. The crisis and reactions by ordinary citizens had serious societal consequences and concerns not just for the those that actively participate in financial markets but all in society. The availability and transparency of public information that was utilized in the research of the viability of a two-factor model that included mid-caps furthered the proposition of informational efficiency of financial markets in the U.S.

My intention from the findings of the study was not to make a direct positive social change as it related to making financial markets becoming more equitable, transparent, and provide a positive mechanism for a prosperous economic society. My purpose of the research was to add to the current knowledge of multifactor models with the examination the aspects of current theories that were not in the forefront of the current literature or research. The main examination was a two-factor and was determined that it was a viable factor and the societal implication was that it provided a more complete theoretical perspective as to the progressions of models from a one factor to multifactor models and filled the gap in the current literature. The second area that I examined was the size factor that included mid-caps in the determination of value based on the size effect anomaly. The results indicated that inclusions of mid-caps did provide an explanation as to the returns of a security or portfolio of securities but was not conclusive if revised two-factor model with mid-caps provided a better multifactor model, but did provide other researchers the ability to further the research as to the size effect anomaly not defined by just small and large capitalized stocks.

The main implication of my study to society was that the data collection, statistical tests, and other methodologies could be replicated and performed by any investor and especially the individual investor with informational and financial constraints. The information that was collected to construct the model and the size factor was all publicly available. Individual stocks were purposefully tested to imitate how an individual investor might use a valuation tool, multifactor model, to make a financial decision. Moreover, the decision to use individual stocks was important since individual investors would not have the funds to purchase many stocks and would either be stock picking or in the process of building a portfolio. Valuation tools, like multifactor models, provided average individual investors the ability to directly make investments equitably if they wished instead of relying on financial products sold by financial institutions. If financial markets were truly informationally efficient and of a strong form then the average investor should be able to participate directly which was not intimated in the current literature on EMH.

Conclusions

One factor, three factors, and now a stand-alone two-factor model had been examined. Since the seminal study by Fama-French (1993) and the introduction of the three factor FF model, post studies had focused on the expansion of the original model by the addition of factors that better determined the value a security or portfolio of securities but no tests specifically on a stand-alone two-factor model. My purpose for this study was to re-examine the second factor or the size factor and to determine if a two-factor model was viable. From the findings from the statistical tests that were performed a stand-alone two-factor model was viable but no evidence that indicated it was better than current multifactor models.

Small caps, large caps, and now mid-caps included in the size factor had been examined. Another area in the current literature that was noticeably overlooked was mid-caps with the focus on small and large caps in current multifactor models. Mid-caps were recognized in financial markets with the many indexes and financial products that were focused on mid-caps, but the theoretical literature focused on the size effect anomaly based on that small caps outperform large caps but ignored how mid-caps returns behave in comparison to small and large caps. It was determined that mid-caps, when added to the size factor construction, produced a size factor provided an explanation of returns of a security or portfolio of securities. The results were not conclusive as to the size effect anomaly or that it provided a better size factor for a multifactor model but did provide evidence that future research in a two-factor model that included mid-caps could produce better valuation tools.

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Appendix A: Model Summaries

Model Summary - Large Capitalized Sized Stocks

Models	Adjusted R Squared	F Change	Sig. F Change
3M Company			
2015 - 2006			
Model 1: (Constant), SMB	0.013	35	0.00
Model 2: (Constant), SMB, HML	0.109	271	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.603	3,126	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.060	81	0.00
Model 2: (Constant), SMB, HML	0.085	35	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.661	2,133	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.001	3	0.11
Model 2: (Constant), SMB, HML	0.136	198	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.579	1,323	0.00
Allstate Corporation			
2015 - 2006			
Model 1: (Constant), SMB	0.001	2	0.12
Model 2: (Constant), SMB, HML	0.270	929	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.585	1,905	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.037	49	0.00
Model 2: (Constant), SMB, HML	0.155	178	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.568	1,200	0.00
2010 - 2006			
Model 1: (Constant), SMB	- 0.000	1	0.39
Model 2: (Constant), SMB, HML	0.312	570	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.592	865	0.00
Prudential Financial, Inc.			
2015 - 2006			
Model 1: (Constant), SMB	- 0.000	0	0.82
Model 2: (Constant), SMB, HML	0.336	1,274	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.640	2,121	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.082	113	0.00
Model 2: (Constant), SMB, HML	0.219	223	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.732	2,400	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.009	13	0.00
Model 2: (Constant), SMB, HML	0.398	814	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.634	810	0.00
IBM			
2015 - 2006			
Model 1: (Constant), SMB	0.006	15	0.00
Model 2: (Constant), SMB, HML	0.054	131	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.512	2,364	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.020	27	0.00
Model 2: (Constant), SMB, HML	0.021	2	0.12
Model 3: (Constant), SMB, HML, MRK_RF	0.430	903	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.000	2	0.21
Model 2: (Constant), SMB, HML	0.088	122	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.567	1,387	0.00
Occidental Petroleum Corp.			
2015 - 2006			
Model 1: (Constant), SMB	0.000	1	0.26
Model 2: (Constant), SMB, HML	0.053	142	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.465	1,939	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.060	82	0.00
Model 2: (Constant), SMB, HML	0.132	105	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.548	1,155	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.004	7	0.01
Model 2: (Constant), SMB, HML	0.052	65	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.463	963	0.00

Model Summary - Medium Capitalized Sized Stocks

Models	Adjusted R Squared	F Change	Sig. F Change
IAC Interactive			
2015 - 2006			
Model 1: (Constant), SMB	0.029	75	0.00
Model 2: (Constant), SMB, HML	0.063	92	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.291	811	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.062	84	0.00
Model 2: (Constant), SMB, HML	0.062	1	0.30
Model 3: (Constant), SMB, HML, MRK_RF	0.279	379	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.012	17	0.00
Model 2: (Constant), SMB, HML	0.097	119	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.313	395	0.00
NetApp, Inc.			
2015 - 2006			
Model 1: (Constant), SMB	0.021	56	0.00
Model 2: (Constant), SMB, HML	0.057	97	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.387	1,354	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.047	63	0.00
Model 2: (Constant), SMB, HML	0.048	2	0.13
Model 3: (Constant), SMB, HML, MRK_RF	0.308	472	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.011	15	0.00
Model 2: (Constant), SMB, HML	0.069	79	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.428	791	0.00
Intercontinental Exchange Inc.			
2015 - 2006			
Model 1: (Constant), SMB	0.003	9	0.00
Model 2: (Constant), SMB, HML	0.090	240	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.385	1,205	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.037	50	0.00
Model 2: (Constant), SMB, HML	0.053	21	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.397	718	0.00
2010 - 2006			
Model 1: (Constant), SMB	- 0.000	1	0.34
Model 2: (Constant), SMB, HML	0.106	150	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.403	627	0.00
Cablevision Systems Corp.			
2015 - 2006			
Model 1: (Constant), SMB	0.007	19	0.00
Model 2: (Constant), SMB, HML	0.096	249	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.315	804	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.028	37	0.00
Model 2: (Constant), SMB, HML	0.030	3	0.07
Model 3: (Constant), SMB, HML, MRK_RF	0.185	240	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.000	2	0.21
Model 2: (Constant), SMB, HML	0.165	248	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.402	499	0.00
Masco Corp.			
2015 - 2006			
Model 1: (Constant), SMB	0.054	145	0.00
Model 2: (Constant), SMB, HML	0.242	624	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.504	1,331	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.099	140	0.00
Model 2: (Constant), SMB, HML	0.116	25	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.440	725	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.034	46	0.00
Model 2: (Constant), SMB, HML	0.336	572	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.550	600	0.00

Model Summary - Small Capitalized Sized Stocks

Models	Adjusted R Squared	F Change	Sig. F Change
National Penn Bancshares, Inc.			
2015 - 2006			
Model 1: (Constant), SMB	0.027	71	0.00
Model 2: (Constant), SMB, HML	0.039	31	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.063	67	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.198	311	0.00
Model 2: (Constant), SMB, HML	0.362	325	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.633	924	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.003	5	0.03
Model 2: (Constant), SMB, HML	0.004	2	0.19
Model 3: (Constant), SMB, HML, MRK_RF	0.005	2	0.14
Crawford & Company			
2015 - 2006			
Model 1: (Constant), SMB	0.111	315	0.00
Model 2: (Constant), SMB, HML	0.162	156	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.318	577	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.185	287	0.00
Model 2: (Constant), SMB, HML	0.211	42	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.349	267	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.080	110	0.00
Model 2: (Constant), SMB, HML	0.143	94	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.306	297	0.00
Snyder's-Lance, Inc.			
2015 - 2006			
Model 1: (Constant), SMB	0.105	296	0.00
Model 2: (Constant), SMB, HML	0.140	104	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.273	461	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.127	183	0.00
Model 2: (Constant), SMB, HML	0.139	20	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.342	388	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.095	133	0.00
Model 2: (Constant), SMB, HML	0.140	67	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.251	186	0.00
Gorman-Rupp Company			
2015 - 2006			
Model 1: (Constant), SMB	0.117	335	0.00
Model 2: (Constant), SMB, HML	0.220	334	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.504	1,438	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.250	420	0.00
Model 2: (Constant), SMB, HML	0.279	51	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.501	561	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.065	89	0.00
Model 2: (Constant), SMB, HML	0.208	228	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.507	762	0.00
Universal Technical Institute, Inc.			
2015 - 2006			
Model 1: (Constant), SMB	0.081	223	0.00
Model 2: (Constant), SMB, HML	0.124	123	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.210	275	0.00
2015 - 2011			
Model 1: (Constant), SMB	0.133	193	0.00
Model 2: (Constant), SMB, HML	0.156	36	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.221	105	0.00
2010 - 2006			
Model 1: (Constant), SMB	0.052	70	0.00
Model 2: (Constant), SMB, HML	0.110	83	0.00
Model 3: (Constant), SMB, HML, MRK_RF	0.208	156	0.00

Appendix B: ANOVA Analysis

ANOVA Analysis - Large Capitalized Sized Stocks

		2015 - 2006		2015 - 2011		2010 - 2006	
3M Company Model		F	Sig.	F	Sig.	F	Sig.
1	Regression	34.664	.000[b]	80.628	.000[b]	2.505	.114[b]
	Residual						
	Total						
2	Regression	154.550	.000[c]	59.155	.000[c]	100.331	.000[c]
	Residual						
	Total						
3	Regression	1273.230	.000[d]	817.493	.000[d]	578.366	.000[d]
	Residual						
	Total						
Allstate Corporation		F	Sig.	F	Sig.	F	Sig.
1	Regression	2.460	.117[b]	48.649	.000[b]	.748	.387[b]
	Residual						
	Total						
2	Regression	466.177	.000[c]	116.512	.000[c]	285.641	.000[c]
	Residual						
	Total						
3	Regression	1181.213	.000[d]	551.911	.000[d]	609.703	.000[d]
	Residual						
	Total						
Prudential Financial, Inc.		F	Sig.	F	Sig.	F	Sig.
1	Regression	.051	.821[b]	112.654	.000[b]	12.624	.000[b]
	Residual						
	Total						
2	Regression	636.888	.000[c]	177.672	.000[c]	417.416	.000[c]
	Residual						
	Total						
3	Regression	1489.505	.000[d]	1144.905	.000[d]	727.384	.000[d]
	Residual						
	Total						
IBM		F	Sig.	F	Sig.	F	Sig.
1	Regression	14.935	.000[b]	26.575	.000[b]	1.562	.212[b]
	Residual						
	Total						
2	Regression	73.284	.000[c]	14.499	.000[c]	61.910	.000[c]
	Residual						
	Total						
3	Regression	882.653	.000[d]	317.610	.000[d]	549.059	.000[d]
	Residual						
	Total						
Petroleum Corporation		F	Sig.	F	Sig.	F	Sig.
1	Regression	1.294	.255[b]	81.733	.000[b]	6.640	.010[b]
	Residual						
	Total						
2	Regression	71.626	.000[c]	96.923	.000[c]	35.812	.000[c]
	Residual						
	Total						
3	Regression	730.981	.000[d]	509.215	.000[d]	363.159	.000[d]
	Residual						
	Total						

a. Dependent Variable: OXY
b. Predictors: (Constant), SMB
c. Predictors: (Constant), SMB, HML
d. Predictors: (Constant), SMB, HML, MRK_RF

ANOVA Analysis - Medium Capitalized Sized Stocks

		2015 - 2006		2015 - 2011		2010 - 2006	
IAC Interactive		F	Sig.	F	Sig.	F	Sig.
1	Regression	75.165	.000[b]	84.234	.000[b]	16.766	.000[b]
	Residual						
	Total						
2	Regression	85.068	.000[c]	42.656	.000[c]	68.645	.000[c]
	Residual						
	Total						
3	Regression	345.268	.000[d]	163.430	.000[d]	191.723	.000[d]
	Residual						
	Total						
NetApp, Inc.		F	Sig.	F	Sig.	F	Sig.
1	Regression	75.165	.000[b]	84.234	.000[b]	16.766	.000[b]
	Residual						
	Total						
2	Regression	85.068	.000[c]	42.656	.000[c]	68.645	.000[c]
	Residual						
	Total						
3	Regression	345.268	.000[d]	163.430	.000[d]	191.723	.000[d]
	Residual						
	Total						
Exchange Inc.		F	Sig.	F	Sig.	F	Sig.
1	Regression	9.450	.002[b]	49.700	.000[b]	.922	.337[b]
	Residual						
	Total						
2	Regression	125.293	.000[c]	35.836	.000[c]	75.760	.000[c]
	Residual						
	Total						
3	Regression	525.170	.000[d]	276.911	.000[d]	284.647	.000[d]
	Residual						
	Total						
Corp.		F	Sig.	F	Sig.	F	Sig.
1	Regression	19.163	.000[b]	37.012	.000[b]	1.599	.206[b]
	Residual						
	Total						
2	Regression	135.081	.000[c]	20.246	.000[c]	125.100	.000[c]
	Residual						
	Total						
3	Regression	386.763	.000[d]	96.029	.000[d]	282.704	.000[d]
	Residual						
	Total						
Masco Corp.		F	Sig.	F	Sig.	F	Sig.
1	Regression	145.041	.000[b]	139.645	.000[b]	45.921	.000[b]
	Residual						
	Total						
2	Regression	402.477	.000[c]	83.867	.000[c]	319.260	.000[c]
	Residual						
	Total						
3	Regression	854.092	.000[d]	329.956	.000[d]	514.275	.000[d]
	Residual						
	Total						

a. Dependent Variable: MAS
b. Predictors: (Constant), SMB
c. Predictors: (Constant), SMB, HML
d. Predictors: (Constant), SMB, HML, MRK_RF

ANOVA Analysis - Small Capitalized Sized Stocks

		2015 - 2006		2015 - 2011		2010 - 2006	
Bancshares, Inc.		F	Sig.	F	Sig.	F	Sig.
1	Regression	70.769	.000[b]	311.139	.000[b]	4.932	.027[b]
	Residual						
	Total						
2	Regression	51.561	.000[c]	358.367	.000[c]	3.346	.036[c]
	Residual						
	Total						
3	Regression	57.503	.000[d]	722.865	.000[d]	2.955	.032[d]
	Residual						
	Total						
Crawford & Company		F	Sig.	F	Sig.	F	Sig.
1	Regression	314.917	.000[b]	286.513	.000[b]	110.026	.000[b]
	Residual						
	Total						
2	Regression	244.990	.000[c]	168.650	.000[c]	105.834	.000[c]
	Residual						
	Total						
3	Regression	392.919	.000[d]	225.271	.000[d]	185.992	.000[d]
	Residual						
	Total						
Snyder's-Lance, Inc.		F	Sig.	F	Sig.	F	Sig.
1	Regression	295.713	.000[b]	183.329	.000[b]	133.240	.000[b]
	Residual						
	Total						
2	Regression	205.901	.000[c]	102.776	.000[c]	103.622	.000[c]
	Residual						
	Total						
3	Regression	315.976	.000[d]	218.983	.000[d]	141.225	.000[d]
	Residual						
	Total						
Rupp Company		F	Sig.	F	Sig.	F	Sig.
1	Regression	335.207	.000[b]	419.881	.000[b]	88.975	.000[b]
	Residual						
	Total						
2	Regression	356.685	.000[c]	244.029	.000[c]	166.288	.000[c]
	Residual						
	Total						
3	Regression	853.011	.000[d]	422.198	.000[d]	432.132	.000[d]
	Residual						
	Total						
Institute, Inc.		F	Sig.	F	Sig.	F	Sig.
1	Regression	222.916	.000[b]	193.142	.000[b]	70.153	.000[b]
	Residual						
	Total						
2	Regression	178.515	.000[c]	117.138	.000[c]	78.753	.000[c]
	Residual						
	Total						
3	Regression	223.741	.000[d]	119.668	.000[d]	110.959	.000[d]
	Residual						
	Total						

a. Dependent Variable: UTI

b. Predictors: (Constant), SMB

c. Predictors: (Constant), SMB, HML

d. Predictors: (Constant), SMB, HML, MRK_RF

Appendix C: Coefficients

Coefficients - Large Capitalized Sized Stocks

		Coefficients: 2015 - 2006				Coefficients: 2015 - 2011				Coefficients: 2010 - 2006			
		Coefficients*				Coefficients*				Coefficients*			
3M Company		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.000	1.102	.270	.001	.000	1.709	.088	.000	.000	.251	.802
	SMB	.281	.048	5.888	.000	.560	.062	8.979	.000	.111	.070	1.583	.114
2	(Constant)	.000	.000	1.244	.214	.001	.000	1.852	.064	.000	.000	.244	.807
	SMB	.350	.045	7.703	.000	.608	.062	9.786	.000	.187	.065	2.861	.004
	HML	.642	.039	16.454	.000	.439	.074	5.956	.000	.692	.049	14.063	.000
3	(Constant)	.000	.000	.214	.830	.000	.000	.091	.927	.000	.000	.022	.982
	SMB	-.031	.031	-.995	.320	-.125	.041	-3.054	.002	-.010	.046	-.212	.832
	HML	-.054	.029	-1.878	.060	.048	.046	1.050	.294	-.050	.040	-1.251	.211
	MRK_RF	.860	.015	55.914	0.000	.976	.021	46.186	.000	.816	.022	36.376	.000
		Coefficients*				Coefficients*				Coefficients*			
Allstate Corporation		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.000	.573	.566	.001	.000	1.808	.071	-8.297E-05	.001	-.103	.918
	SMB	.117	.074	1.568	.117	.483	.069	6.975	.000	-.105	.122	-.865	.387
2	(Constant)	.000	.000	.827	.408	.001	.000	2.197	.028	.000	.001	-.168	.867
	SMB	.298	.064	4.669	.000	.594	.065	9.086	.000	.095	.101	.940	.348
	HML	1.670	.055	30.479	.000	1.034	.078	13.324	.000	1.826	.076	23.879	.000
3	(Constant)	.000	.000	-.191	.849	.000	.000	.858	.391	.000	.001	-.483	.629
	SMB	-.174	.049	-3.524	.000	-.086	.051	-1.694	.090	-.177	.079	-2.251	.025
	HML	.808	.046	17.633	.000	.671	.056	11.885	.000	.798	.068	11.656	.000
	MRK_RF	1.066	.024	43.648	0.000	.905	.026	34.642	.000	1.131	.038	29.409	.000
		Coefficients*				Coefficients*				Coefficients*			
Prudential Financial, Inc.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.001	.001	.845	.398	.001	.001	1.004	.315	.001	.001	.650	.516
	SMB	-.026	.115	-.226	.821	1.032	.097	10.614	.000	-.674	.190	-3.553	.000
2	(Constant)	.001	.001	1.221	.222	.001	.000	1.388	.165	.001	.001	.782	.435
	SMB	.287	.094	3.052	.002	1.204	.090	13.321	.000	-.323	.148	-2.180	.029
	HML	2.878	.081	35.689	.000	1.601	.107	14.926	.000	3.189	.112	28.531	.000
3	(Constant)	.000	.000	.299	.765	.000	.000	-.760	.447	.001	.001	.746	.456
	SMB	-.429	.071	-6.047	.000	.115	.057	1.995	.046	-.713	.116	-6.126	.000
	HML	1.570	.066	23.857	.000	1.020	.064	15.943	.000	1.716	.101	16.923	.000
	MRK_RF	1.615	.035	46.051	0.000	1.450	.030	48.991	.000	1.620	.057	28.456	.000
		Coefficients*				Coefficients*				Coefficients*			
IBM		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.000	.906	.365	.000	.000	.137	.891	.000	.000	1.100	.272
	SMB	.180	.047	3.865	.000	.338	.066	5.155	.000	.083	.066	1.250	.212
2	(Constant)	.000	.000	.988	.323	.000	.000	.168	.867	.000	.000	1.131	.258
	SMB	.229	.046	5.013	.000	.351	.066	5.313	.000	.141	.063	2.220	.027
	HML	.448	.039	11.440	.000	.121	.079	1.547	.122	.528	.048	11.050	.000
3	(Constant)	.000	.000	-.058	.954	.000	.000	-1.696	.090	.000	.000	1.305	.192
	SMB	-.129	.034	-3.840	.000	-.285	.055	-5.209	.000	-.052	.044	-1.188	.235
	HML	-.206	.031	-6.590	.000	-.218	.061	-3.579	.000	-.201	.038	-5.236	.000
	MRK_RF	.808	.017	48.617	0.000	.848	.028	30.050	.000	.801	.022	37.239	.000
		Coefficients*				Coefficients*				Coefficients*			
Occidental Petroleum Corporation		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.001	.468	.639	.000	.000	-.196	.844	.001	.001	.765	.444
	SMB	.097	.085	1.138	.255	.821	.091	9.041	.000	-.347	.135	-2.577	.010
2	(Constant)	.000	.000	.543	.587	.000	.000	.001	.999	.001	.001	.770	.442
	SMB	.190	.084	2.275	.023	.936	.088	10.639	.000	-.259	.132	-1.966	.050
	HML	.853	.072	11.912	.000	1.071	.104	10.263	.000	.799	.099	8.040	.000
3	(Constant)	.000	.000	-.577	.564	-.001	.000	-2.166	.031	.000	.001	.743	.457
	SMB	-.431	.064	-6.695	.000	.030	.069	.435	.664	-.624	.100	-6.249	.000
	HML	-.280	.060	-4.688	.000	.588	.077	7.670	.000	-.579	.087	-6.659	.000
	MRK_RF	1.400	.032	44.037	0.000	1.206	.035	33.992	.000	1.516	.049	31.032	.000

** Unstandardized*

Coefficients - Medium Capitalized Sized Stocks

		Coefficients: 2015 - 2006				Coefficients: 2015 - 2011				Coefficients: 2010 - 2006			
		Coefficients*				Coefficients*				Coefficients*			
IAC Interactive		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.000	1.124	.261	.001	.000	1.696	.090	.000	.001	.097	.923
	SMB	.514	.059	8.670	.000	.825	.090	9.178	.000	.325	.079	4.095	.000
2	(Constant)	.000	.000	1.193	.233	.001	.000	1.675	.094	.000	.001	.082	.935
	SMB	.566	.058	9.683	.000	.813	.091	8.971	.000	.394	.076	5.171	.000
	HML	.482	.050	9.604	.000	-.111	.108	-1.036	.301	.627	.057	10.906	.000
3	(Constant)	.000	.000	.532	.595	.000	.000	.665	.506	.000	.000	-.085	.932
	SMB	.241	.052	4.624	.000	.164	.086	1.898	.058	.238	.067	3.546	.000
	HML	-.112	.048	-2.316	.021	-.458	.096	-4.772	.000	.035	.058	.601	.548
	MRK_RF	.734	.026	28.476	.000	.865	.044	19.475	.000	.651	.033	19.870	.000
		Coefficients*				Coefficients*				Coefficients*			
NetApp, Inc.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.000	1.124	.261	.001	.000	1.696	.090	.000	.001	.097	.923
	SMB	.514	.059	8.670	.000	.825	.090	9.178	.000	.325	.079	4.095	.000
2	(Constant)	.000	.000	1.193	.233	.001	.000	1.675	.094	.000	.001	.082	.935
	SMB	.566	.058	9.683	.000	.813	.091	8.971	.000	.394	.076	5.171	.000
	HML	.482	.050	9.604	.000	-.111	.108	-1.036	.301	.627	.057	10.906	.000
3	(Constant)	.000	.000	.532	.595	.000	.000	.665	.506	.000	.000	-.085	.932
	SMB	.241	.052	4.624	.000	.164	.086	1.898	.058	.238	.067	3.546	.000
	HML	-.112	.048	-2.316	.021	-.458	.096	-4.772	.000	.035	.058	.601	.548
	MRK_RF	.734	.026	28.476	.000	.865	.044	19.475	.000	.651	.033	19.870	.000
		Coefficients*				Coefficients*				Coefficients*			
Intercontinental Exchange Inc.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.001	.001	1.937	.053	.001	.000	1.843	.066	.002	.001	1.435	.151
	SMB	.319	.104	3.074	.002	.561	.080	7.050	.000	.168	.175	.960	.337
2	(Constant)	.001	.001	2.107	.035	.001	.000	1.949	.051	.002	.001	1.496	.135
	SMB	.463	.100	4.648	.000	.608	.080	7.635	.000	.337	.166	2.029	.043
	HML	1.322	.085	15.500	.000	.435	.094	4.602	.000	1.539	.125	12.267	.000
3	(Constant)	.001	.000	1.537	.124	.000	.000	.730	.465	.001	.001	1.606	.109
	SMB	-.175	.084	-2.090	.037	-.107	.069	-1.549	.122	-.066	.137	-.482	.630
	HML	.158	.078	2.037	.042	.054	.077	.699	.485	.015	.119	.126	.900
	MRK_RF	1.438	.041	34.712	.000	.951	.035	26.797	.000	1.676	.067	25.038	.000
		Coefficients*				Coefficients*				Coefficients*			
Cablevision Systems Corp.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.001	.788	.431	.000	.001	.424	.672	.001	.001	.742	.458
	SMB	.376	.086	4.378	.000	.738	.121	6.084	.000	.153	.121	1.264	.206
2	(Constant)	.000	.000	.907	.365	.000	.001	.461	.645	.001	.001	.783	.434
	SMB	.497	.082	6.040	.000	.767	.122	6.275	.000	.298	.111	2.684	.007
	HML	1.113	.070	15.783	.000	.268	.145	1.846	.065	1.319	.084	15.757	.000
3	(Constant)	.000	.000	.205	.838	.000	.001	-.486	.627	.000	.001	.724	.469
	SMB	.041	.073	.557	.577	.039	.122	.317	.751	.049	.095	.519	.604
	HML	.281	.068	4.130	.000	-.121	.135	-.893	.372	.379	.082	4.605	.000
	MRK_RF	1.028	.036	28.352	.000	.970	.063	15.488	.000	1.033	.046	22.333	.000
		Coefficients*				Coefficients*				Coefficients*			
Masco Corp.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.001	.506	.613	.001	.001	1.632	.103	.000	.001	-.465	.642
	SMB	1.087	.090	12.043	.000	1.400	.118	11.817	.000	.900	.133	6.776	.000
2	(Constant)	.000	.000	.693	.488	.001	.001	1.748	.081	.000	.001	-.605	.546
	SMB	1.277	.081	15.723	.000	1.476	.118	12.476	.000	1.118	.110	10.124	.000
	HML	1.739	.070	24.980	.000	.707	.140	5.038	.000	1.992	.083	23.911	.000
3	(Constant)	.000	.000	-.219	.827	.000	.000	.474	.636	-.001	.001	-.955	.340
	SMB	.739	.067	10.977	.000	.411	.102	4.022	.000	.854	.092	9.334	.000
	HML	.757	.062	12.135	.000	.139	.114	1.223	.222	.995	.080	12.478	.000
	MRK_RF	1.213	.033	36.488	.000	1.418	.053	26.932	.000	1.097	.045	24.492	.000

** Unstandardized*

Coefficients - Small Capitalized Sized Stocks

		Coefficients: 2015 - 2006				Coefficients: 2015 - 2011				Coefficients: 2010 - 2006			
		Coefficients*				Coefficients*				Coefficients*			
National Penn Bancshares, Inc.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.001	.346	.730	.001	.000	1.334	.183	.000	.001	-.095	.924
	SMB	.815	.097	8.412	.000	1.576	.089	17.639	.000	.350	.158	2.221	.027
2	(Constant)	.000	.001	.377	.707	.001	.000	1.857	.064	.000	.001	-.098	.922
	SMB	.865	.097	8.950	.000	1.761	.080	21.922	.000	.368	.158	2.324	.020
	HML	.465	.083	5.612	.000	1.719	.095	18.035	.000	.158	.119	1.326	.185
3	(Constant)	.000	.001	.140	.888	.000	.000	.503	.615	.000	.001	-.111	.911
	SMB	.690	.098	7.056	.000	.983	.066	14.862	.000	.340	.159	2.135	.033
	HML	.146	.091	1.607	.108	1.304	.074	17.711	.000	.054	.139	.389	.697
	MRK_RF	.395	.048	8.167	.000	1.036	.034	30.405	.000	.115	.078	1.472	.141
		Coefficients*				Coefficients*				Coefficients*			
Crawford & Company		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.001	.001	.910	.363	.001	.001	1.295	.196	.000	.001	.305	.761
	SMB	2.377	.134	17.746	.000	2.786	.165	16.927	.000	2.129	.203	10.489	.000
2	(Constant)	.001	.001	1.002	.317	.001	.001	1.444	.149	.000	.001	.298	.766
	SMB	2.529	.131	19.367	.000	2.920	.163	17.879	.000	2.286	.197	11.633	.000
	HML	1.397	.112	12.478	.000	1.249	.194	6.445	.000	1.433	.148	9.672	.000
3	(Constant)	.000	.001	.402	.688	.000	.001	.545	.586	.000	.001	.176	.860
	SMB	1.894	.121	15.688	.000	1.903	.161	11.823	.000	1.925	.178	10.811	.000
	HML	.238	.112	2.125	.034	.706	.179	3.942	.000	.070	.155	.450	.653
	MRK_RF	1.432	.060	24.012	.000	1.355	.083	16.341	.000	1.500	.087	17.219	.000
		Coefficients*				Coefficients*				Coefficients*			
Snyder's-Lance, Inc.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.000	.941	.347	.001	.000	1.202	.230	.000	.001	.339	.734
	SMB	1.133	.066	17.196	.000	1.108	.082	13.540	.000	1.149	.100	11.543	.000
2	(Constant)	.000	.000	1.012	.312	.001	.000	1.299	.194	.000	.001	.333	.739
	SMB	1.195	.065	18.419	.000	1.154	.082	14.091	.000	1.215	.097	12.480	.000
	HML	.567	.056	10.197	.000	.430	.097	4.418	.000	.601	.073	8.186	.000
3	(Constant)	.000	.000	.467	.640	.000	.000	.227	.821	.000	.001	.234	.815
	SMB	.907	.061	14.843	.000	.562	.078	7.237	.000	1.068	.092	11.668	.000
	HML	.042	.057	.749	.454	.114	.086	1.313	.189	.046	.080	.576	.565
	MRK_RF	.648	.030	21.466	.000	.789	.040	19.698	.000	.611	.045	13.635	.000
		Coefficients*				Coefficients*				Coefficients*			
Gorman-Rupp Company		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.001	.791	.429	.000	.001	.572	.568	.001	.001	.683	.494
	SMB	1.833	.100	18.309	.000	2.492	.122	20.491	.000	1.428	.151	9.433	.000
2	(Constant)	.001	.001	.936	.349	.000	.001	.726	.468	.001	.001	.715	.475
	SMB	1.994	.094	21.101	.000	2.602	.120	21.640	.000	1.603	.140	11.462	.000
	HML	1.480	.081	18.270	.000	1.022	.143	7.166	.000	1.591	.105	15.085	.000
3	(Constant)	.000	.000	.055	.956	.000	.001	-.638	.524	.000	.001	.657	.511
	SMB	1.352	.077	17.502	.000	1.608	.108	14.828	.000	1.242	.111	11.174	.000
	HML	.309	.072	4.313	.000	.492	.121	4.076	.000	.226	.097	2.340	.019
	MRK_RF	1.447	.038	37.920	.000	1.324	.056	23.682	.000	1.501	.054	27.609	.000
		Coefficients*				Coefficients*				Coefficients*			
Universal Technical Institute, Inc.		B	Std. Error	t	Sig.	B	Std. Error	t	Sig.	B	Std. Error	t	Sig.
1	(Constant)	.000	.001	-.718	.473	-.001	.001	-.950	.342	.000	.001	-.029	.977
	SMB	1.408	.094	14.930	.000	1.960	.141	13.898	.000	1.069	.128	8.376	.000
2	(Constant)	.000	.001	-.679	.497	-.001	.001	-.843	.399	.000	.001	-.047	.963
	SMB	1.504	.093	16.258	.000	2.067	.140	14.736	.000	1.163	.124	9.368	.000
	HML	.881	.079	11.103	.000	.996	.166	5.982	.000	.852	.094	9.099	.000
3	(Constant)	-.001	.001	-1.204	.229	-.001	.001	-1.530	.126	.000	.001	-.162	.871
	SMB	1.177	.090	13.071	.000	1.486	.146	10.169	.000	.989	.118	8.390	.000
	HML	.283	.083	3.395	.001	.686	.163	4.215	.000	.197	.103	1.915	.056
	MRK_RF	.738	.044	16.591	.000	.773	.075	10.260	.000	.720	.058	12.488	.000

** Unstandardized*

Appendix D: Correlation Matrix

Correlation Matrix - Large Capitalized Sized Stocks

		2015 - 2006				2015 - 2011				2010 - 2006			
3M Company		MMM	SMB	HML	MRK_RF	MMM	SMB	HML	MRK_RF	MMM	SMB	HML	MRK_RF
Pearson Correlation	MMM	1.000	.117	.297	.776	1.000	.246	.128	.811	1.000	.045	.364	.761
	SMB	.117	1.000	-.093	.161	.246	1.000	-.127	.365	.045	1.000	-.083	.060
	HML	.297	-.093	1.000	.409	.128	-.127	1.000	.125	.364	-.083	1.000	.503
	MRK_RF	.776	.161	.409	1.000	.811	.365	.125	1.000	.761	.060	.503	1.000
Sig. (1-tailed)	MMM		.000	.000	0.000		.000	.000	.000		.057	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.057		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	0.000	.000	.000		.000	.000	.000		.000	.017	.000	
Allstate Corporation		Al	SMB	HML	MRK_RF	Al	SMB	HML	MRK_RF	Al	SMB	HML	MRK_RF
Pearson Correlation	Al	1.000	.031	.514	.725	1.000	.193	.318	.718	1.000	-.024	.559	.738
	SMB	.031	1.000	-.093	.161	.193	1.000	-.127	.365	-.024	1.000	-.083	.060
	HML	.514	-.093	1.000	.409	.318	-.127	1.000	.125	.559	-.083	1.000	.503
	MRK_RF	.725	.161	.409	1.000	.718	.365	.125	1.000	.738	.060	.503	1.000
Sig. (1-tailed)	Al		.058	.000	0.000		.000	.000	.000		.194	.000	.000
	SMB	.058		.000	.000	.000		.000	.000	.194		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	0.000	.000	.000		.000	.000	.000		.000	.017	.000	
Prudential Financial, Inc.		PRU	SMB	HML	MRK_RF	PRU	SMB	HML	MRK_RF	PRU	SMB	HML	MRK_RF
Pearson Correlation	PRU	1.000	-.004	.578	.737	1.000	.287	.332	.823	1.000	-.100	.630	.729
	SMB	-.004	1.000	-.093	.161	.287	1.000	-.127	.365	-.100	1.000	-.083	.060
	HML	.578	-.093	1.000	.409	.332	-.127	1.000	.125	.630	-.083	1.000	.503
	MRK_RF	.737	.161	.409	1.000	.823	.365	.125	1.000	.729	.060	.503	1.000
Sig. (1-tailed)	PRU		.411	.000	0.000		.000	.000	0.000		.000	.000	.000
	SMB	.411		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	0.000	.000	.000		0.000	.000	.000		.000	.017	.000	
IBM		IBM	SMB	HML	MRK_RF	IBM	SMB	HML	MRK_RF	IBM	SMB	HML	MRK_RF
Pearson Correlation	IBM	1.000	.077	.214	.709	1.000	.144	.024	.645	1.000	.035	.294	.747
	SMB	.077	1.000	-.093	.161	.144	1.000	-.127	.365	.035	1.000	-.083	.060
	HML	.214	-.093	1.000	.409	.024	-.127	1.000	.125	.294	-.083	1.000	.503
	MRK_RF	.709	.161	.409	1.000	.645	.365	.125	1.000	.747	.060	.503	1.000
Sig. (1-tailed)	IBM		.000	.000	0.000		.000	.193	.000		.106	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.106		.002	.017
	HML	.000	.000		.000	.193	.000		.000	.000	.002		.000
	MRK_RF	0.000	.000	.000		.000	.000	.000		.000	.017	.000	
Occidental Petroleum		OXY	SMB	HML	MRK_RF	OXY	SMB	HML	MRK_RF	OXY	SMB	HML	MRK_RF
Pearson Correlation	OXY	1.000	.023	.228	.674	1.000	.247	.236	.726	1.000	-.072	.226	.658
	SMB	.023	1.000	-.093	.161	.247	1.000	-.127	.365	-.072	1.000	-.083	.060
	HML	.228	-.093	1.000	.409	.236	-.127	1.000	.125	.226	-.083	1.000	.503
	MRK_RF	.674	.161	.409	1.000	.726	.365	.125	1.000	.658	.060	.503	1.000
Sig. (1-tailed)	OXY		.128	.000	0.000		.000	.000	.000		.005	.000	.000
	SMB	.128		.000	.000	.000		.000	.000	.005		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	0.000	.000	.000		.000	.000	.000		.000	.017	.000	

Correlation Matrix - Medium Capitalized Sized Stocks

		2015 - 2006				2015 - 2011				2010 - 2006			
IAC Interactive		IAC	SMB	HML	MRK_RF	IAC	SMB	HML	MRK_RF	IAC	SMB	HML	MRK_RF
Pearson Correlation	IAC	1.000	.170	.169	.532	1.000	.251	-.060	.513	1.000	.115	.282	.554
	SMB	.170	1.000	-.093	.161	.251	1.000	-.127	.365	.115	1.000	-.083	.060
	HML	.169	-.093	1.000	.409	-.060	-.127	1.000	.125	.282	-.083	1.000	.503
	MRK_RF	.532	.161	.409	1.000	.513	.365	.125	1.000	.554	.060	.503	1.000
Sig. (1-tailed)	IAC		.000	.000	.000		.000	.017	.000		.000	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.017	.000		.000	.000	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.000	.017	.000	
NetAPP, Inc.		NTAP	SMB	HML	MRK_RF	NTAP	SMB	HML	MRK_RF	NTAP	SMB	HML	MRK_RF
Pearson Correlation	NTAP	1.000	.147	.176	.616	1.000	.219	.014	.554	1.000	.110	.232	.644
	SMB	.147	1.000	-.093	.161	.219	1.000	-.127	.365	.110	1.000	-.083	.060
	HML	.176	-.093	1.000	.409	.014	-.127	1.000	.125	.232	-.083	1.000	.503
	MRK_RF	.616	.161	.409	1.000	.554	.365	.125	1.000	.644	.060	.503	1.000
Sig. (1-tailed)	NTAP		.000	.000	.000		.000	.311	.000		.000	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.311	.000		.000	.000	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.000	.017	.000	
Intercontinental Exchange Inc.		ICE	SMB	HML	MRK_RF	ICE	SMB	HML	MRK_RF	ICE	SMB	HML	MRK_RF
Pearson Correlation	ICE	1.000	.061	.288	.619	1.000	.195	.100	.630	1.000	.027	.324	.636
	SMB	.061	1.000	-.093	.161	.195	1.000	-.127	.365	.027	1.000	-.083	.060
	HML	.288	-.093	1.000	.409	.100	-.127	1.000	.125	.324	-.083	1.000	.503
	MRK_RF	.619	.161	.409	1.000	.630	.365	.125	1.000	.636	.060	.503	1.000
Sig. (1-tailed)	ICE		.001	.000	.000		.000	.000	.000		.169	.000	.000
	SMB	.001		.000	.000	.000		.000	.000	.169		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.000	.017	.000	
Cablevision Systems Corp		CVC	SMB	HML	MRK_RF	CVC	SMB	HML	MRK_RF	CVC	SMB	HML	MRK_RF
Pearson Correlation	CVC	1.000	.087	.290	.558	1.000	.169	.029	.431	1.000	.036	.402	.627
	SMB	.087	1.000	-.093	.161	.169	1.000	-.127	.365	.036	1.000	-.083	.060
	HML	.290	-.093	1.000	.409	.029	-.127	1.000	.125	.402	-.083	1.000	.503
	MRK_RF	.558	.161	.409	1.000	.431	.365	.125	1.000	.627	.060	.503	1.000
Sig. (1-tailed)	CVC		.000	.000	.000		.000	.149	.000		.103	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.103		.002	.017
	HML	.000	.000		.000	.149	.000		.000	.000	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.000	.017	.000	
Masco Corp		MAS	SMB	HML	MRK_RF	MAS	SMB	HML	MRK_RF	MAS	SMB	HML	MRK_RF
Pearson Correlation	MAS	1.000	.234	.410	.678	1.000	.316	.092	.659	1.000	.188	.532	.689
	SMB	.234	1.000	-.093	.161	.316	1.000	-.127	.365	.188	1.000	-.083	.060
	HML	.410	-.093	1.000	.409	.092	-.127	1.000	.125	.532	-.083	1.000	.503
	MRK_RF	.678	.161	.409	1.000	.659	.365	.125	1.000	.689	.060	.503	1.000
Sig. (1-tailed)	MAS		.000	.000	0.000		.000	.001	.000		.000	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.001	.000		.000	.000	.002		.000
	MRK_RF	0.000	.000	.000		.000	.000	.000		.000	.017	.000	

Correlation Matrix - Small Capitalized Sized Stocks

		2015 - 2006				2015 - 2011				2010 - 2006			
National Penn Bancshares, Inc.		NPBC	SMB	HML	MRK_RF	NPBC	SMB	HML	MRK_RF	NPBC	SMB	HML	MRK_RF
Pearson Correlation	NPBC	1.000	.165	.094	.214	1.000	.446	.346	.708	1.000	.063	.032	.058
	SMB	.165	1.000	-.093	.161	.446	1.000	-.127	.365	.063	1.000	-.083	.060
	HML	.094	-.093	1.000	.409	.346	-.127	1.000	.125	.032	-.083	1.000	.503
	MRK_RF	.214	.161	.409	1.000	.708	.365	.125	1.000	.058	.060	.503	1.000
Sig. (1-tailed)	NPBC		.000	.000	.000		.000	.000	.000		.013	.128	.019
	SMB	.000		.000	.000	.000		.000	.000	.013		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.128	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.019	.017	.000	

		2015 - 2006				2015 - 2011				2010 - 2006			
Crawford & Company		CRD.B	SMB	HML	MRK_RF	CRD.B	SMB	HML	MRK_RF	CRD.B	SMB	HML	MRK_RF
Pearson Correlation	CRD.B	1.000	.334	.196	.503	1.000	.431	.105	.526	1.000	.284	.228	.493
	SMB	.334	1.000	-.093	.161	.431	1.000	-.127	.365	.284	1.000	-.083	.060
	HML	.196	-.093	1.000	.409	.105	-.127	1.000	.125	.228	-.083	1.000	.503
	MRK_RF	.503	.161	.409	1.000	.526	.365	.125	1.000	.493	.060	.503	1.000
Sig. (1-tailed)	CRD.B		.000	.000	.000		.000	.000	.000		.000	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.000	.017	.000	

		2015 - 2006				2015 - 2011				2010 - 2006			
Snyder's-Lance, Inc.		LNCE	SMB	HML	MRK_RF	LNCE	SMB	HML	MRK_RF	LNCE	SMB	HML	MRK_RF
Pearson Correlation	LNCE	1.000	.324	.157	.457	1.000	.357	.069	.562	1.000	.310	.188	.413
	SMB	.324	1.000	-.093	.161	.357	1.000	-.127	.365	.310	1.000	-.083	.060
	HML	.157	-.093	1.000	.409	.069	-.127	1.000	.125	.188	-.083	1.000	.503
	MRK_RF	.457	.161	.409	1.000	.562	.365	.125	1.000	.413	.060	.503	1.000
Sig. (1-tailed)	LNCE		.000	.000	.000		.000	.007	.000		.000	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.007	.000		.000	.000	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.000	.017	.000	

		2015 - 2006				2015 - 2011				2010 - 2006			
Gorman-Rupp Company		GRC	SMB	HML	MRK_RF	GRC	SMB	HML	MRK_RF	GRC	SMB	HML	MRK_RF
Pearson Correlation	GRC	1.000	.343	.288	.666	1.000	.501	.106	.644	1.000	.257	.356	.677
	SMB	.343	1.000	-.093	.161	.501	1.000	-.127	.365	.257	1.000	-.083	.060
	HML	.288	-.093	1.000	.409	.106	-.127	1.000	.125	.356	-.083	1.000	.503
	MRK_RF	.666	.161	.409	1.000	.644	.365	.125	1.000	.677	.060	.503	1.000
Sig. (1-tailed)	GRC		.000	.000	0.000		.000	.000	.000		.000	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	0.000	.000	.000		.000	.000	.000		.000	.017	.000	

		2015 - 2006				2015 - 2011				2010 - 2006			
Universal Technical Institute, Inc.		UTI	SMB	HML	MRK_RF	UTI	SMB	HML	MRK_RF	UTI	SMB	HML	MRK_RF
Pearson Correlation	UTI	1.000	.285	.180	.396	1.000	.365	.107	.394	1.000	.230	.222	.406
	SMB	.285	1.000	-.093	.161	.365	1.000	-.127	.365	.230	1.000	-.083	.060
	HML	.180	-.093	1.000	.409	.107	-.127	1.000	.125	.222	-.083	1.000	.503
	MRK_RF	.396	.161	.409	1.000	.394	.365	.125	1.000	.406	.060	.503	1.000
Sig. (1-tailed)	UTI		.000	.000	.000		.000	.000	.000		.000	.000	.000
	SMB	.000		.000	.000	.000		.000	.000	.000		.002	.017
	HML	.000	.000		.000	.000	.000		.000	.000	.002		.000
	MRK_RF	.000	.000	.000		.000	.000	.000		.000	.017	.000	

Appendix E: Durbin-Watson Statistic

Research Question #1	FF Model		
Individual Stocks	2015 - 2006	2015 - 2011	2010 - 2006
3M Company	1.998	2.113	1.934
Allstate Corporation	2.178	2.037	2.218
Prudential Financial, Inc.	2.070	2.073	2.073
IBM	1.899	1.804	1.974
Occidental Petroleum Corp.	1.970	1.944	1.968
IAC Interactive	2.046	1.988	2.094
NetApp, Inc.	2.047	1.956	2.097
Intercontinental Exchange Inc.	2.016	1.974	2.038
Cablevision Systems Corp.	2.016	1.968	2.060
Masco Corp.	2.006	2.037	1.981
National Penn Bancshares, Inc.	2.497	1.922	2.388
Crawford & Company	1.991	2.388	2.014
Snyder's-Lance, Inc.	2.039	2.087	2.012
Gorman-Rupp Company	2.082	2.004	2.131
Universal Technical Institute, Inc.	2.056	2.012	2.088

Research Question #3 Revised	Revised Two-Factor Model		
Individual Stocks	2015 - 2006	2015 - 2011	2010 - 2006
3M Company	2.009	2.107	1.946
Allstate Corporation	2.180	2.065	2.224
Prudential Financial, Inc.	2.068	2.069	2.095
IBM	1.900	1.816	1.964
Occidental Petroleum Corp.	1.968	1.945	1.968
IAC Interactive	2.046	2.001	2.096
NetApp, Inc.	2.057	1.965	2.107
Intercontinental Exchange Inc.	2.031	1.974	2.046
Cablevision Systems Corp.	2.011	1.969	2.048
Masco Corp.	1.993	2.039	1.961
National Penn Bancshares, Inc.	2.484	2.011	2.380
Crawford & Company	1.992	1.938	2.017
Snyder's-Lance, Inc.	2.037	2.072	2.012
Gorman-Rupp Company	2.085	1.987	2.139
Universal Technical Institute, Inc.	2.060	2.008	2.102

Research Question #2	Two-Factor Model		
3 Portfolios (Size)	2015 - 2006	2015 - 2011	2010 - 2006
Russell Top 50 Mega	1.860	1.839	1.876
Russell Midcap	1.902	1.869	1.929
Russell 2000	1.918	1.872	1.959

Research Question #2	FF Model		
3 Portfolios (Size)	2015 - 2006	2015 - 2011	2010 - 2006
Russell Top 50 Mega	1.949	1.892	1.980
Russell Midcap	1.904	1.865	1.929
Russell 2000	2.043	2.012	1.976

Research Question #3	Two-Factor Model		
9 Portfolios (Size & B/M)	2015 - 2006	2015 - 2011	2010 - 2006
R2000V	2.057	2.039	2.047
R2000	1.918	1.872	1.959
R2000G	1.949	1.969	1.889
MidV	2.121	2.007	2.187
Mid	1.902	1.869	1.929
MidG	1.912	1.950	1.892
T200V	1.923	1.981	1.901
T200	1.888	1.871	1.909
T200G	1.970	2.005	1.985

Research Question #3 Revised	Revised Two-Factor Model		
9 Portfolios (Size & B/M)	2015 - 2006	2015 - 2011	2010 - 2006
R2000V	2.002	1.982	1.992
R2000	1.968	1.955	1.977
R2000G	2.017	2.027	1.978
MidV	2.134	2.065	2.169
Mid	1.965	1.949	1.973
MidG	2.030	2.031	2.025
T200V	1.965	2.017	1.967
T200	1.977	1.970	1.977
T200G	1.956	2.020	1.952