THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF FINANCE

THE INVESTMENT TRIANGLE: AN ANALYSIS OF HOW PORTFOLIO TURNOVER AFFECTS RISK AND FUND PERFORMANCE

AURELIE DENIS
SPRING 2016

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Finance
with honors in Finance

Reviewed and approved* by the following:

Christoph Hinkelmann
Clinical Assistant Professor of Finance
Thesis Supervisor

Brian Davis
Clinical Associate Professor of Finance
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

Following the popular notion that increased expenses will decrease returns, investors are often fixated on a fund's expense ratio when deciding where to invest their money. Portfolio turnover, on the other hand, is a variable that is often overlooked. It may be that a higher turnover causes increased expenses though and therefore decreased returns for investors. In addition, if a portfolio manager decides to trade more or less in any given time period, this may influence the overall risk profile of the fund and may not actually lead to superior asset selection decisions. Past research conducted on portfolio turnover and its impact on return and risk is limited and many of the findings are contradictory. To bring additional insight to the existing body of research, this thesis explores these relations using data from 2004 to 2014 for a sample of United States domiciled mutual funds. It was found that portfolio turnover has very limited impact on returns and standard deviation for both equity and fixed income funds. For equity funds, the predominant driver of performance and risk was found to be market forces. In bond funds, the correlations analyzed were generally weak, and as a result the key drivers are uncertain. In conclusion, there are other forces aside from portfolio turnover that heavily sway mutual fund performance and risk regardless of the underlying assets.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to extend a special thank you to my thesis supervisor, Dr. Christoph Hinkelmann, and my honors adviser, Dr. Brian Davis, for their guidance and support throughout this project.

In addition, I would like to sincerely thank Jim Rowley, Senior Investment Analyst at Vanguard, and the rest of the Investment Strategy Group for teaching me a tremendous amount about research during my summer internship. Your willingness to share your expertise and knowledge of the field with me and your overwhelming aid throughout the entire process was irreplaceable.

Finally, and above all else, I would like to thank my family and dearest friends for your unconditional love and encouragement during the countless ups and downs. I owe the completion of this thesis to your unwavering support and motivation.

Chapter 1

Introduction

Different investment asset classes have varied risk profiles and, as a result, produce differentiated returns over time. Assets with a greater risk profile are expected to generate higher returns over the long run to compensate for the additional volatility that they exhibit. However, within the same asset class category, the level of portfolio management activity, measured by frequency of transactions, may vary and in turn might have a significant effect on mutual fund risk and performance. The situation is therefore more complex than simply risk driving performance. One should also consider how often the portfolio turns over. This analysis considers the effect of portfolio turnover on risk and fund performance.

Morningstar defines portfolio turnover as "...a measure of the fund's trading activity, which is computed by taking the lesser of purchases or sales (excluding all securities with maturities of less than one year) and dividing by average monthly net assets." Unfortunately, readjustments of asset allocation can often cause increased costs, such as elevated brokerage commissions and significant price impacts, and therefore lower returns for investors. On the other hand, a higher frequency of transactions can sometimes mean that portfolio managers are able to find underpriced securities and therefore deliver higher returns to their investors. Managers may also incur risk when trading too frequently or too infrequently. Intuitively it is hard to find an evident connection between portfolio turnover and risk. Nevertheless, one may exist. Khorana (1996) found that fund managers trade more frequently after encountering poor performance. One could speculate that in an attempt to recover these losses, a portfolio manager

may purchase riskier securities and therefore end up with a higher turnover rate and a portfolio with an increased degree of uncertainty. One may also hypothesize that when a portfolio manager makes more frequent decisions regarding a client's portfolio allocation, they are more likely to buy or sell the wrong securities. However, the opposing view can also be stated. A portfolio manager who has a low frequency of transactions could be holding on to the wrong securities. This thesis will assess to what extent portfolio turnover affects risk and fund performance. More specifically, it will answer the questions: "Is portfolio turnover positively or negatively related to fund performance?" and "Is portfolio turnover positively or negatively related to risk?"

Hypotheses

Portfolio Turnover and Performance: Portfolio turnover and performance will exhibit a negative correlation for all asset classes and investment strategies. This stems from the belief that higher portfolio turnover leads to increased costs, such as supplementary brokerage commissions, and therefore lower returns for investors. In addition, it is unlikely that an increased portfolio turnover signifies a portfolio manager's ability to make superior asset selection decisions.

Portfolio Turnover and Risk: Portfolio turnover and risk will exhibit a positive correlation for all asset classes and investment strategies. This stems from the belief that a higher rate of portfolio turnover leads to a greater chance of mistake and therefore raises the risk that an investor faces.

Chapter 2

Literature Review

Portfolio Turnover and Performance

A significant amount of research has been conducted regarding portfolio turnover and performance and the outcome is still unclear. The relation between these two factors can be analyzed in both directions. Some researchers have discovered that frequency of trading has a profound effect on performance while additional analysis implies that performance can influence a portfolio manager's decision of trading frequency.

Carhart (1997) found that expense ratios, portfolio turnover, and load fees are negatively related to performance. Using monthly data of diversified equity funds free of survivor bias from January 1962 to December 1993, he found that expenses have a one-for-one negative impact on fund performance and that for every buy and sell transaction fund performance is reduced approximately 95 basis points.

Similarly, Barber and Odean (2000) found that frequency of trading and transaction costs, as opposed to weak portfolio selection, explain the poor investments of households. Using data from 78,000 U.S. households from 1991 through 1996, the study investigated the performance of individual investors who maintain equity portfolios without the help of a broker. A household's net returns, after accounting for the bid-ask spread and commissions paid by the investor, underperformed a value-weighted market index by about 9 basis points per month. Additionally, they discovered that the average household turns about 75 percent of its portfolio annually.

Within this group, those that trade most often have returns that fall below a value-weighted market index by 46 basis points per month.

Taking a gender spin on the turnover and performance investigation, Barber and Odean (2001) tested the hypothesis that men are more confident than women and because of this trade more often and incur lower returns on their investments than their female counterparts. They divided common stock portfolios of men and women from 35,000 households within the U.S. from 1991 to 1997. They discovered that the average portfolio turnover for men is one and a half times that of women causing their returns to decrease by 0.94 percentage points a year more than women. Because this study focused heavily on the influence of gender on investments, they further divided their data set into single men and single women and married men and married women. In doing so, they found that single men trade 67 percent more than single women and reduce their returns significantly when doing so. Furthermore, the difference in trading and returns between single men and single women was larger than between that of married men and married women thus proving that your spouse does in fact influence your trading activity. In addition, they further solidified their belief that increased portfolio turnover does in fact cause a reduction in performance.

Conflictingly, Grinblatt (1994) conducted research on 279 mutual funds and 109 passive portfolios and found that performance is positively related to portfolio turnover. This finding suggests that those firms that spend more money on researching and executing trades may be uncovering underpriced stocks. Differing from each of these past studies, Ippolito (1989) found no relation between portfolio turnover and fund performance. By analyzing data from 143 mutual funds between 1965 to 1984 in an attempt to test the efficiency of the mutual fund

industry, he found no evidence indicating that turnover and fees are correlated with inferior returns.

Edelen, Evans, and Kadlec (2013) extended research on the relation between portfolio turnover and performance. They used data from 1,758 domestic equity funds from 1995 to 2006 to further investigate the relation between portfolio turnover and the costs it causes a fund to incur. In order to quantify these transaction costs, they found the position change of each stock by using quarterly portfolio holdings data. Then, for every position change, they estimated the cost of trading that amount of that specific stock in that quarter by calculating the brokerage commission, bid-ask spread, and price impact of each trade. Finally, they calculated the funds annual expenditures by aggregating all of the costs for the fund over a year. While no significant relationship was initially identified between portfolio turnover and performance, they did find a stark negative correlation between portfolio turnover and performance when calculating a position adjusted turnover. Position adjusted turnover can be computed by multiplying a fund turnover by its average position size relative to other funds in its market capitalization category.

Although portfolio turnover has been found to affect fund performance in a variety of ways, performance likewise influences trading frequency. Khorana (1996) found that fund managers are more likely to engage in increased trading activity in an attempt to cover up prior inferior performance in order to avoid disappointment from others or even unemployment. Fund performance and portfolio turnover simultaneously affect each other as poor performance incentivizes managers to increase their trading frequency and an increase in portfolio turnover can have a negative or positive effect on fund performance.

In an attempt to expand on these studies using more recent data, Wu (2014) used monthly data from 170 open-end equity funds located in Taiwan from 2003 to 2012. The focus on

Taiwanese funds was an attempt to better mimic the rest of the world outside of the U.S. as the U.S. mutual fund industry differs from international markets in regards to assets under management and holding of the domestic equity market. Wu found that funds with the highest portfolio turnover had the worst performance while funds with the lowest portfolio turnover encountered the most success. In addition, he discovered that portfolio turnover was positively correlated with expenses. Consistent with Khorana's results, he also found that the underperforming funds adjusted their portfolio allocation more frequently.

The past research conducted on portfolio turnover and performance is quite inconclusive and focuses almost entirely on equity funds or a small sample of mutual funds. The most recent study omits the United States mutual fund industry entirely in an attempt to investigate the relationship present in other international markets. Through an analysis of portfolio turnover and fund performance within U.S. domiciled mutual funds, this thesis will fill the clear gap that exists in previous research.

Portfolio Turnover and Risk

Preceding research regarding the relation between portfolio turnover and risk is essentially non-existent and instead focuses on one or the other. As noted from the previous literature review section, the studies conducted on portfolio turnover focus almost entirely on analyzing its relation with return. The research completed in terms of risk focuses on its relation with return as well. Nowhere is there an analysis of how portfolio turnover relates to risk, as measured by standard deviation.

The lack of research on this topic may be due to the fact that investors care more about how risk affects return as opposed to what causes risk. In addition, there has already been a significant amount of research conducted on various items that do in fact indicate risk. For example, it is common knowledge that some funds have higher risk characteristics than others. An equity fund invested solely in small-cap companies is a much riskier investment than a fund invested entirely in large-cap companies. Likewise, a fixed income fund invested in international bonds has a much higher risk profile than a fund invested in government bonds. Another example of a variable that communicates risk is the ratings given by companies such as Fitch, Moody's, and Standard & Poor's, on debt. These ratings gauge how likely a company is to default on its obligations and therefore signal to investors how risky that investment may be. Because of this existing research that reveals to investors that these variables do in fact imply risk, it seems that analyzing other mutual fund characteristics, such as portfolio turnover and its impact on standard deviation in particular, has been overlooked.

While it may not seem important after investigating the underlying assets of the fund, portfolio turnover may in fact have a relationship with risk which would likely lead to higher or lower returns. On one hand, a portfolio manager may be very active in regard to their portfolio management style. While this may lead to increased returns if the manager is able to purchase undervalued assets and sell overvalued ones with certainty, it could also lead to an increase in poor decisions. On the opposite side of the spectrum, a portfolio manager may take a very passive approach, rarely making any investment management decisions. Although it seems that this is the best way to avoid unnecessary mistakes, it is also important to notice that the manager could then be neglecting to make critical decisions on assets that need immediate attention.

Another potential reason for the shortfall of exploration conducted on this topic could be publication bias. When a researcher spends countless months or possibly even years to investigate a certain topic in the hopes to be published in a prestigious journal, they feel as though the only type of success is one that proves their initial hypothesis. Due to this, researchers will occasionally only submit positive data, ignoring negative data and inconclusive data in its entirety ("Advisory Note", 2011). This should not be the case though as results, even those deemed unfavorable or ambiguous, add value to the existing body of knowledge. It may be the case that research on portfolio turnover and its effect on risk has indeed been done before but the conclusion was considered unimportant and therefore was not released to the general public.

Since previous research neglects to analyze how portfolio turnover affects risk, this thesis will be filling this gap by understanding how portfolio turnover impacts the standard deviation of returns in U.S. domiciled mutual funds.

Importance of Bond Funds

While the previous literature regarding portfolio turnover and risk is non-existent, the research on portfolio turnover and how it affects returns focuses more heavily on equity funds than bond funds. In much the same way, the public and the media are constantly putting the equity market in the limelight featuring its volatility on a daily basis. This is likely due to the fact that bond investors generally invest in the long run while equity investors seem to make decisions on their portfolios much more often. In addition, the stock market is perceived to be an indicator of the health of a company and the economy as a whole (Tang). But the attention on the

stock market is still shocking when one realizes that its size is insignificant when compared to the bond market.

As of mid-2015, the United States bond market is one of the biggest financial markets in the world with 39.5 trillion dollars outstanding. This is not only equivalent to one and a half times the size of the United States stock markets but is also almost twice the size of the sum of the five largest foreign equity markets. In addition to the market itself being immense, the influx of cash into United States bond mutual and exchange-traded funds has skyrocketed since 2007. While approximately 1.5 trillion dollars has been transferred into these investment tools, only about 829 billion dollars has been invested in stock funds. With this, bond mutual and exchange-traded funds now own 17 percent of all corporate bonds, more than doubling the previous eight percent from 2008 (Barr, 2015). The size comparison between the equity market and the bond market is largely due to who issues these securities. While both corporations and the government are able to issue fixed income securities, only businesses can issue stock (Tang).

With the size and growth of the United States bond market being so powerful, it is unclear as to why financial research so often omits it in lieu of the stock market. In an effort to counter these actions, this thesis will investigate the relationships between portfolio turnover and returns and risk in a sample of exclusively equity funds and again in a sample of solely bond funds.

Chapter 3

Data and Methodology

Data Collection and Calculations

In an attempt to elaborate on former research, this thesis performs an analysis on a large sample size that represents the entire United States and that includes not only equity funds but fixed income funds as well. To do so, data was retrieved from Morningstar Direct beginning with all 30,000 United States domiciled mutual funds that exist. In addition to the basic information that Morningstar provides such as name and ticker, the annual report net expense ratio, the absolute monthly return, the absolute yearly return, and the yearly turnover ratio for a ten year time period from 2004 to 2014 for each mutual fund was collected.

This data was sorted by oldest share class, and only those that were in fact the oldest share class were retained; doing so eliminated duplicates of the same fund. The sample was further narrowed by filtering the remaining funds by their U.S. category group, a field provided by Morningstar. Only the funds that invest in municipal bonds, taxable bonds, or U.S. equities were retained. Those whose underlying securities consist of sector equity, international equity, alternatives, allocation, or commodities were eliminated. This allows a focus solely on funds that are invested in either stocks *or* fixed income. Categories such as commodities and alternatives include investments other than equities and bonds. In addition, the allocation category includes funds of funds, such as target-date funds, and instead of obtaining turnover data about their

underlying securities, their underlying funds would have been analyzed. These variations from equity and fixed income would have likely skewed the analysis.

The data was then refined by examining the style boxes that Morningstar describes as "...a nine-square grid that provides a graphical representation of the "investment style" of stocks and mutual funds. For stocks and stock funds, it classifies securities according to market capitalization (the vertical axis) and growth and value factors (the horizontal axis). Fixed income funds are classified according to credit quality (the vertical axis) and sensitivity to changes in interest rates (the horizontal axis)." These style boxes can be seen below in Figures 1 and 2. All equity and fixed income funds that did not have consistent style information were eliminated.

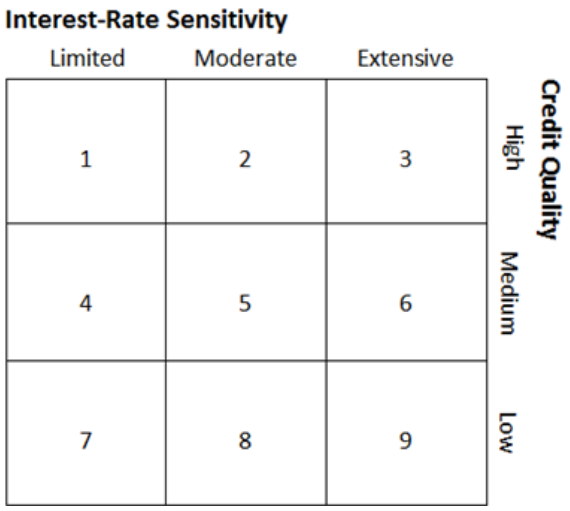

Figure 1. Fixed Income Fund Style Box

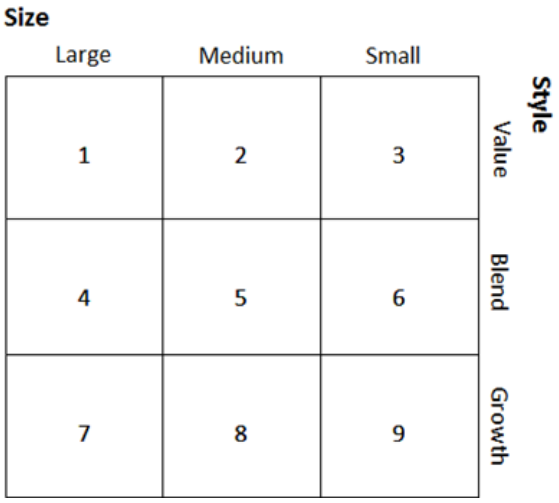

Figure 2. Equity Fund Style Box

With the remaining 3,686 mutual funds, a variety of metrics were calculated to further the analysis. For each fund, the annualized standard deviation of monthly returns was calculated. First, the standard deviation of monthly returns for each fund was found. In order to convert this standard deviation of monthly returns into the annualized standard deviation of monthly returns, it was multiplied by the square root of the frequency, in this case twelve since monthly data points were used.

$$\text{2004 Annualized Standard Deviation of Monthly Returns} = \underbrace{[\text{Stdev (2004 Monthly Returns)}]}_{\text{Standard Deviation of Monthly Returns}} * \sqrt{12}$$

Figure 3. Annualized Standard Deviation of Monthly Returns Equation

In addition, yearly range of return for each fund was calculated by subtracting the minimum monthly return from the maximum monthly return. While the difference between the annualized standard deviation of monthly returns and the yearly range of returns may not seem evident at first, it is worth noting. The standard deviation calculated states that if the data has a normal distribution and therefore appears in the shape of a bell curve, about 68, 95, and 99.7 percent of all observations are within one, two, and three standard deviations of the mean respectively (Rumsey, 2011). The interpretation of standard deviation omits outliers while the range includes them and therefore accounts for all variability.

Furthermore, the yearly beta for each fund was found by estimating the slope using monthly returns as the dependent variable and monthly returns of an index that invests in similar assets as the independent variable. The Russell 3000 index was used for equity funds and the Barclay's U.S. Aggregate Bond Index was used for bond funds. For each of the above metrics, a missing value was inserted if the equation was unable to be calculated due to unavailable data.

The portfolio turnover data analyzed exhibits the distribution pattern of a geometric sequence shown in Figure 4. On the other hand, returns follow an arithmetic sequence. It would therefore be incorrect to attempt to find a linear relation between a value that increases exponentially, such as turnover, and one that increases linearly, such as return. In addition, regression analyses run on linear relations. To overcome the issue of the portfolio turnover data being a geometric sequence, the log of turnover for each fund's yearly turnover ratio was

calculated which transformed the geometric sequence into linearized data. The normal distribution of log of turnover, which represents an arithmetic sequence, can be seen in Figure 5.

Since it is impossible to take the log of zero, and therefore impossible to calculate the log of turnover for funds with a turnover of zero, a 0.01 was inserted for log of turnover for funds that had a yearly turnover ratio of zero.

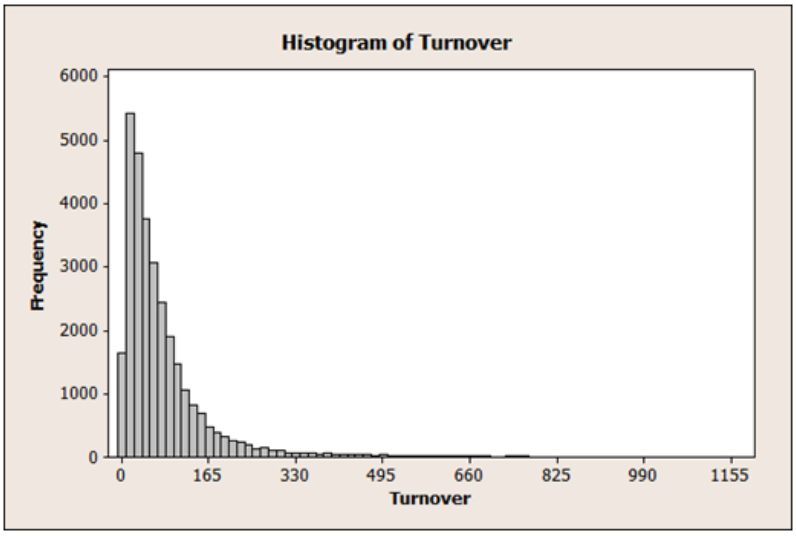

Figure 4. Histogram of Turnover

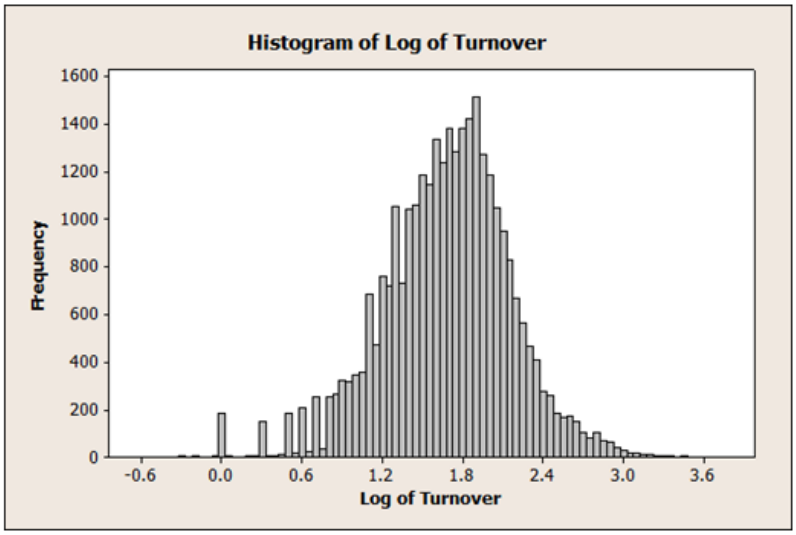

Figure 5. Histogram of Log Turnover

Once all of these calculations were complete, all funds that had a missing value for any of the fields listed below were removed:

- Annual report net expense ratio
- Annual turnover ratio
- Annual absolute return
- Annualized standard deviation of monthly returns
- Annual range of returns
- Annual beta

After all of this trimming, the final sample consisted of 3,561 United States domiciled mutual funds including 2,223 investing in U.S. equities and 1,338 investing in either municipal bonds or taxable bonds.

Methodology

To start the analysis and begin with the basics, a variety of descriptive statistics regarding the sample of data were found. In addition, various relationships between variables in equity funds and fixed income funds were graphed. This was done simply to view any fundamental relationships within the data.

The bulk of the analysis focuses on regression analysis performed on Minitab. In total, four regressions were completed, two for equity funds and two for bond funds. For each asset class, a regression was performed that analyzes the effect multiple variables have on standard deviation. This same analysis was then repeated to view the effect on returns. By doing so, an

attempt was made to find out what impact log of turnover has on risk, calculated by standard deviation, and performance, gauged by yearly returns.

Each regression analysis is broken up into four "panels". The first panel, panel A, examines the relationship log of turnover has with standard deviation or returns depending on what regression is being observed. Panel B adds a multitude of control variables into the regression equation including expense ratio and beta. Next, Panel C takes into account all of the years and uses 2014 as the control group. Finally, Panel D expands the regression equation by adding the 9 categories represented in the Morningstar style boxes. The control group for equity funds and fixed income funds is large blend and low moderate respectively.

The conclusions were derived predominantly from observing the various statistical measurements found in the regression analysis such as the coefficients, R-squares, and Durbin-Watson statistics. The analyses and results can be found within the following chapters.

Chapter 4

Descriptive Statistics and Fundamental Relations

Descriptive statistics for equity funds and bond funds are shown below in Tables 1 and 2. In addition, relationships between log of turnover and a variety of other variables for both equity and bond funds were graphed.

Some trends are worth noting. For the sample of equity funds, the difference between the 95^{th} percentile and 5^{th} percentile of annual returns is an enormous 75.24 percent. This variability of returns is also represented through the large 95^{th} percentile of the annualized standard deviation of monthly returns at 27.23 percent. Of course, it is likely that this tremendous range of returns was caused by the financial crisis that occurred in 2008. As expected, the market downturn had a lesser effect on bond funds which is depicted through the narrower 21.49 percent difference between the 95^{th} percentile and 5^{th} percentile of annual returns. In addition, the 95^{th} percentile of the annualized standard deviation of monthly returns for the bond funds sample is much smaller, at just 10.35.

Surprisingly, the sample of bond funds has a much larger 95^{th} percentile of yearly turnover at 392 percent in comparison to that of equity funds at 199 percent. This higher turnover for bond funds is also represented through a higher yearly turnover average of 102.65 percent compared to 74.99 percent for equity funds. These differences are likely caused by the frequency of transactions in these funds. While most equity indices rebalance on a yearly basis, bond indices do so more often, approximately every month. The rebalancing of fixed income indices

takes into consideration various items such as coupon payments, newly issued bonds, and even bonds that have been called prior to maturity (Tucker, 2011). Although the sample of mutual funds used for this thesis is not entirely index funds, it is likely that those included skewed the descriptive statistics to demonstrate the relationship of higher turnover in bond index funds than in equity index funds.

Table 1. Equity Funds Descriptive Statistics

Equity Funds						
	Expense Ratio	**Return**	**Turnover**	**Log of Turnover**	**Standard Deviation**	**Beta (Russell)**
0.95	1.90%	38.28%	199.00%	2.30	27.23%	1.53
0.75	1.36	21.27	93.00	1.97	20.01	1.20
Median	1.14	12.37	53.00	1.72	12.89	1.04
0.25	0.87	3.85	27.00	1.43	9.74	0.93
0.05	0.35	-36.96	7.00	0.85	7.26	0.73
Std Deviation	0.46	19.75	91.69	0.45	6.55	0.26

Table 2. Bond Funds Descriptive Statistics

Bond Funds						
	Expense Ratio	**Return**	**Turnover**	**Log of Turnover**	**Standard Deviation**	**Beta (Barclays)**
0.95	1.40%	15.67%	392.00%	2.59	10.35%	1.66
0.75	0.93	7.64	106.00	2.03	5.07	1.05
Median	0.76	4.03	47.00	1.67	3.31	0.77
0.25	0.56	1.44	20.51	1.31	2.23	0.36
0.05	0.23	-5.82	7.77	0.89	0.81	-0.15
Std Deviation	0.33	8.49	199.10	0.53	3.25	0.62

One unforeseen relationship was discovered upon graphing Figure 6. Clearly, there are two distinct ovals in the graph depicting a period of typical annual returns and a period of below average annual returns within equity funds; this is likely a representation of the housing bubble and the subsequent unforgiving financial crisis. Regardless of the differences in performance, both ovals seem to be centered horizontally, neither having a noteworthy positive or negative slope. This likely shows that despite the market situation, the impact turnover has on annual

returns is the same. In addition, it seems that log of turnover does not have a significant positive or negative effect on annual returns within equity funds. This relationship conflicts with my initial hypothesis and the common belief that an increase in portfolio turnover will cause lower returns due to increased transaction costs. Furthermore, both ovals seem to be directly above each other with neither having a higher or lower average log of turnover signifying that portfolio managers likely do not change their rebalancing methodology based upon the conditions of the overall market.

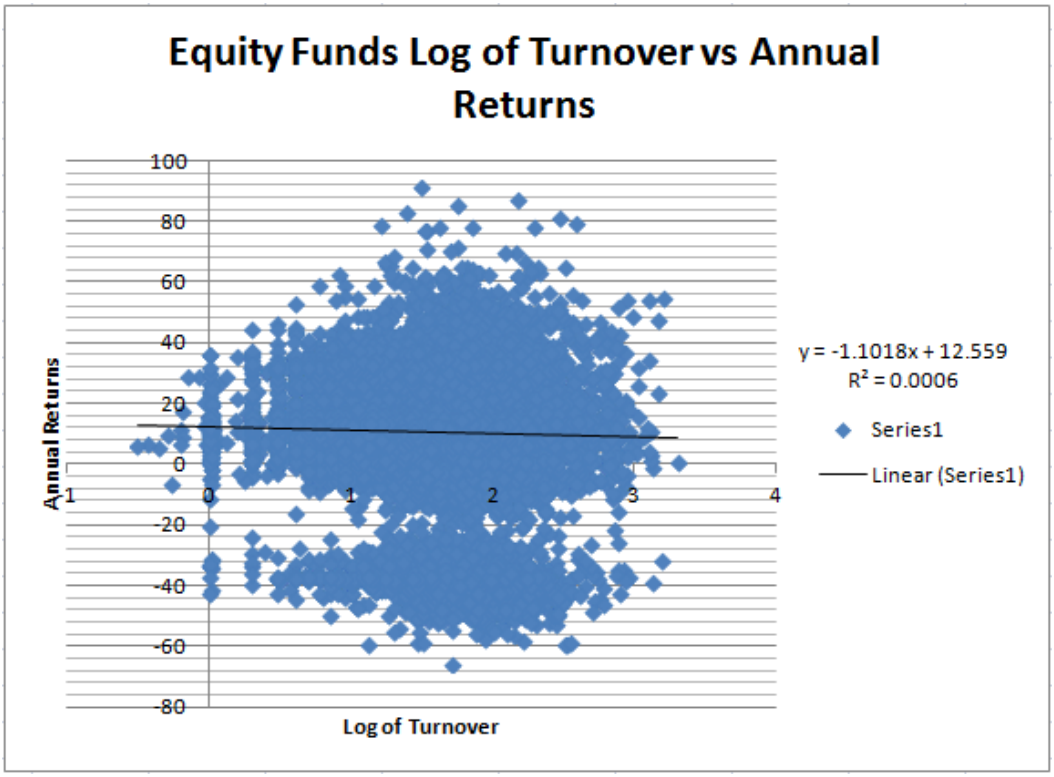

Figure 6. Equity Funds Log of Turnover vs. Annual Returns

Although Figure 6 implies that increased portfolio turnover does not have a significant negative effect on returns, Figure 7 does show that an increase in log of turnover is likely positively correlated with an increased expense ratio within equity funds depicted by a positive

slope. It is expected that the heightened expense ratio would cause decreased performance but it seems annual returns of equity funds are predominantly determined by overall market conditions.

Figure 8 shows that an augmentation in portfolio turnover is generally associated with an increase in risk through a larger standard deviation within equity funds. On the other hand, Figure 9, shows that log of turnover seems to have almost no impact on risk in bond funds.

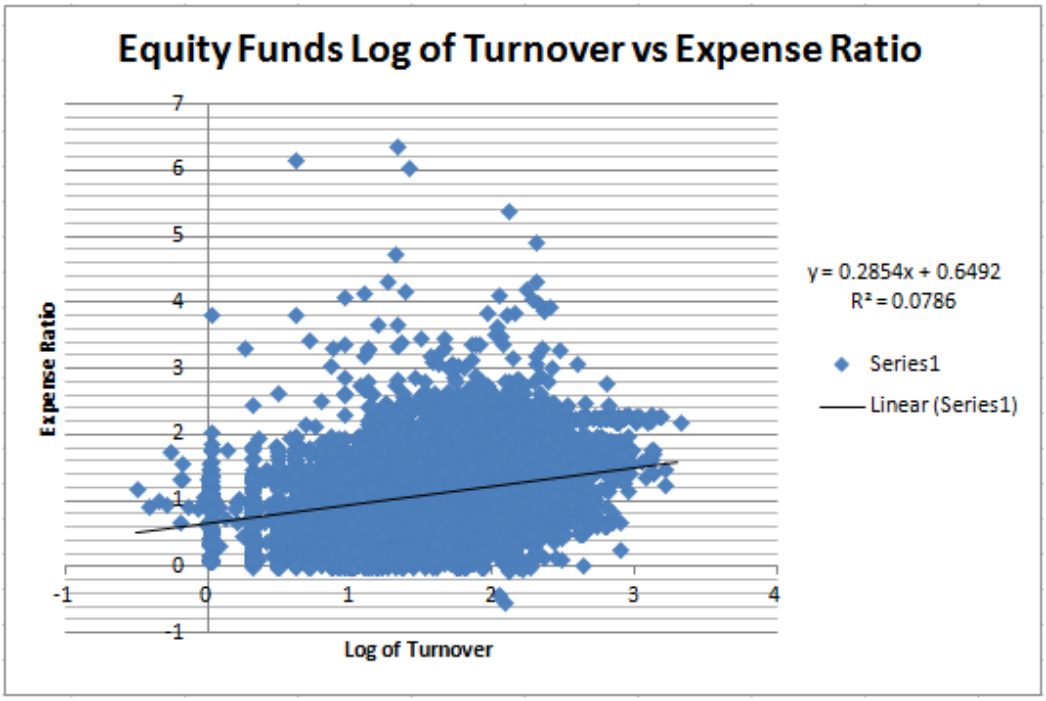

Figure 7. Equity Funds Log of Turnover vs. Expense Ratio

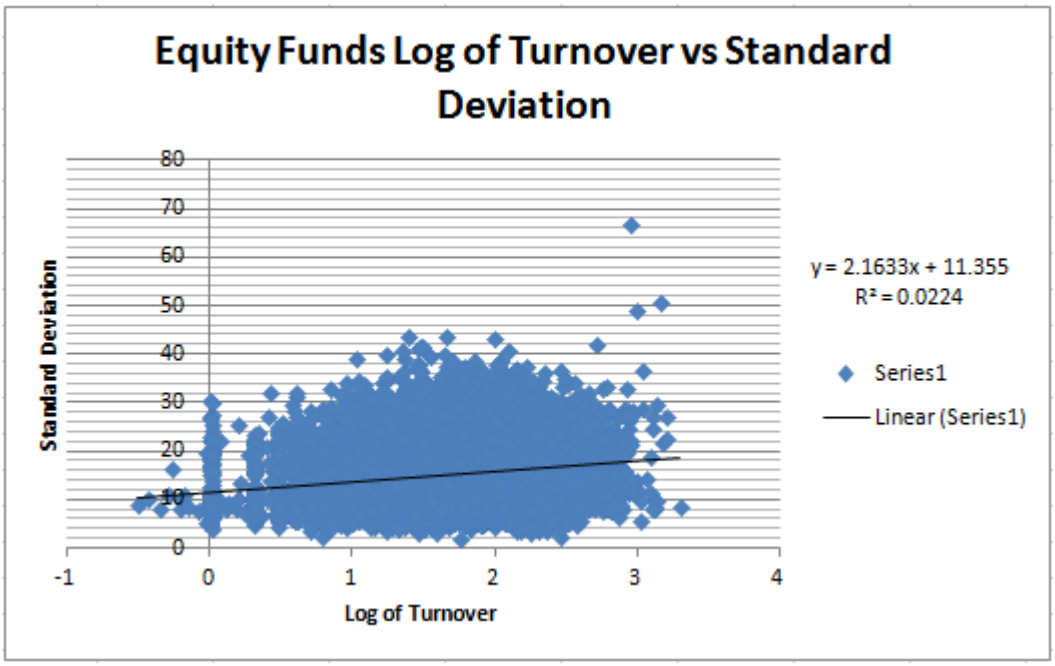

Figure 8. Equity Funds Log of Turnover vs. Standard Deviation

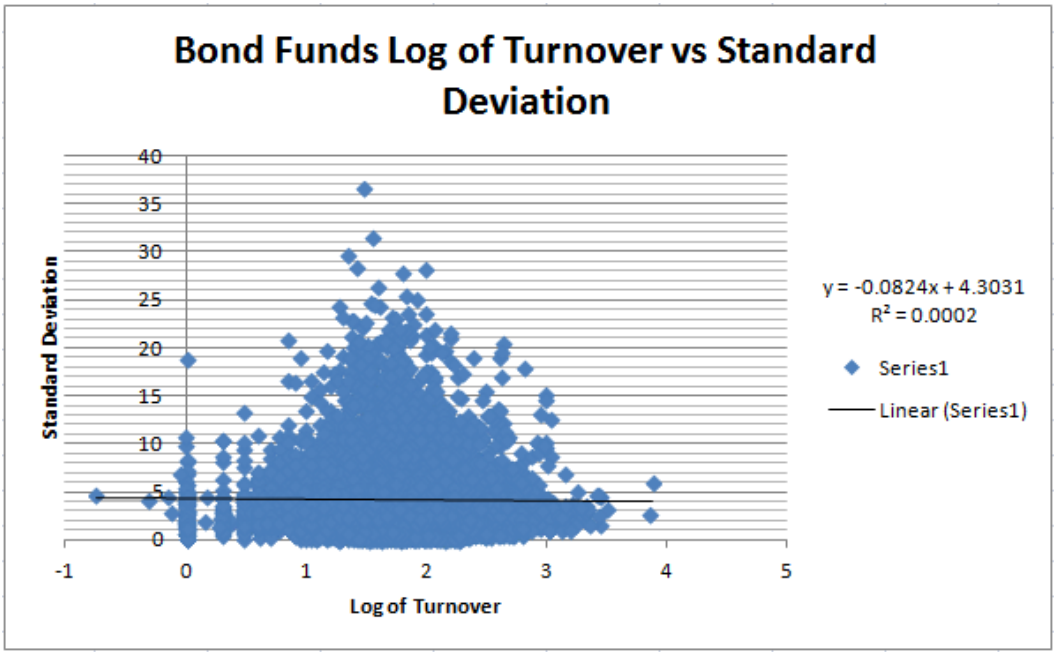

Figure 9. Bond Funds Log of Turnover vs. Standard Deviation

Figure 10 seems to tell a similar story as that of Figure 6. It appears that log of turnover within bond funds does not affect annual returns in a positive or negative way. On the other hand, there are clear peaks in the center of the data showing periods of both tremendously high

and staggeringly low annual returns likely again due to the housing bubble and eventual financial crisis.

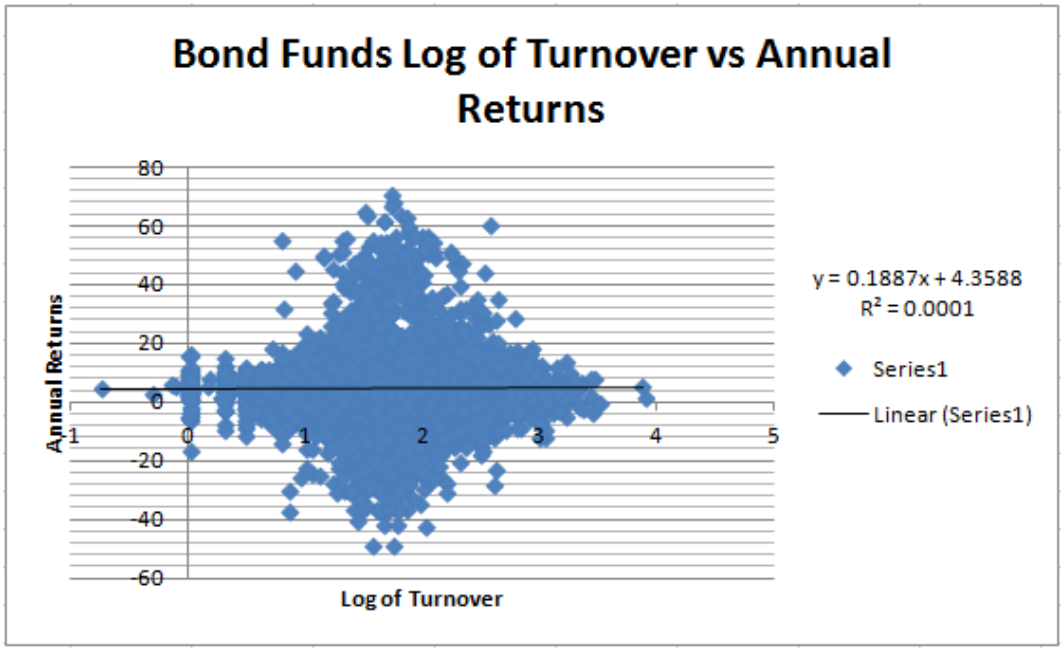

Figure 10. Bond Funds Log of Turnover vs. Annual Returns

While various other relationships were graphed with log of turnover as the independent variable, their data does not directly affect this thesis and therefore these figures can be located in Appendix A. In order to yield more telling data regarding the relationship portfolio turnover has with risk and return within mutual funds, the next portion of this thesis focuses on regression analyses of these variables within equity and bond funds.

Chapter 5

Regression Analysis on Equity Funds

Regression Analysis on Equity Fund Return

The first regression analysis completed was that of equity fund returns. In the panels discussed below, one can see the statistical variables change considerably as additional predictors are added to the regression.

Panel A of this regression analysis, shown in Table 3, shows the regression equation including only the constant and log of turnover. Here, both predictors are found to be statistically significant with a p-value less than .05. In addition, for every increase of one unit in log of turnover, returns decrease by 1.1018 percent. The R-squared in this panel is only at 0.1 percent showing that this regression equation does not explain 99.9 percent of the model's variability.

Table 3. Panel A

Predictor	Coefficient	P-value
Constant	12.5586	0.000
Log of Turnover	-1.1018	0.000
R-Sq = 0.1%		

In Panel B, shown in Table 4, the story changes only slightly. Here, only the constant and beta are found to be statistically significant and log of turnover has become insignificant. It is interesting to note that for an increase in beta of one, returns decrease by over eight percent. This relationship may be due to the inclusion of the financial crisis in the ten year time period of the

sample data. The addition of expense ratio and beta to the regression equation only causes the R-squared to increase to 1.1 percent.

Table 4. Panel B

Predictor	Coefficient	P-value
Constant	19.7942	0.000
Log of Turnover	-0.3458	0.297
Expense Ratio	0.1250	0.698
Beta	-8.0110	0.000
R-Sq = 1.1%		

Panel C, in Table 5, continues to expand the regression equation by adding each individual year as a predictor. Here, only the year 2005 is found not to be statistically significant with a rather large p-value of 0.507. Log of turnover has become statistically significant again showing a positive correlation with returns through a coefficient of 0.4258. While one can say that an increase in log of turnover of 1 unit causes returns to increase by 0.4258 percent, it may make more sense to analyze this relationship on a smaller scope by examining how returns change when log of turnover goes from the median value of 1.72 (53%) to the 75th percentile value of 1.97 (93%). This difference in log of turnover causes about one-fourth of the difference, increasing returns by just 0.104 from 7.96 percent to 8.06 percent. In addition, an increase in one percent in expense ratio now causes returns to decrease by 0.4898 percent. Beta continues to be negatively correlated with returns but with a now smaller coefficient of -1.3713.

Table 5. Panel C

Predictor	Coefficient	P-value
Constant	9.2563	0.000
Log of Turnover	0.4258	0.000
Expense Ratio	-0.4898	0.000
Beta	-1.3713	0.000
2004	5.9795	0.000
2005	-0.1543	0.507
2006	5.7880	0.000
2007	-1.0355	0.000
2008	-45.6979	0.000
2009	24.8399	0.000
2010	11.5482	0.000
2011	-9.7766	0.000
2012	7.0912	0.000
2013	26.5622	0.000
R-Sq = 88.2%		

Simply because a data point is located in the year 2008, it has a negative correlation with returns. This is depicted through the coefficient of -45.6979 and likely due to the market downfall that occurred during that time period. The addition of the years to the regression equation caused the R-squared to soar to 88.2 percent, forcing one to believe that market forces are a significant driver of changes in equity fund returns.

Panel D, shown in Table 6, attempts to dive further into the details by adding the fund styles to the regression equation. While the analysis shows that log of turnover is positively correlated with returns, it is important to notice that with a p-value of 0.081, the coefficient has become insignificant. Both expense ratio and beta continue to be negatively correlated with equity fund returns. Interestingly enough, expense ratio has an almost one to one relationship with returns as every increase in one percent of expenses causes performance to decrease by -.9251 percent, a relationship also found in Carhart's study. Although all but one of the fund styles were found to be significant, the R-squared only increased by .03 percent to 88.5 percent from

Panel C. Thus, reaffirming the belief that overall market conditions have the most impact on equity fund returns.

Table 6. Panel D

Predictor	Coefficient	P-value
Constant	11.0860	0.000
Log of Turnover	0.2015	0.081
Expense Ratio	-0.9251	0.000
Beta	-3.5301	0.000
2004	6.2008	0.000
2005	0.0067	0.977
2006	6.2240	0.000
2007	-1.2288	0.000
2008	-45.6921	0.000
2009	24.6441	0.000
2010	11.4083	0.000
2011	-9.7297	0.000
2012	7.0373	0.000
2013	26.3603	0.000
Small Value	2.4502	0.000
Small Blend	2.3795	0.000
Small Growth	2.9425	0.000
Mid Value	1.9960	0.000
Mid Blend	2.0576	0.000
Mid Growth	2.9048	0.000
Large Value	-0.2240	0.178
Large Growth	1.2747	0.000
R-Sq = 88.5%		

The Fama and French Three Factor Model states that after adjusting for risk, value funds actually perform better than growth funds and small funds continue to perform better than large funds ("The Fama-French Three-Factor Model," n.d.). While the returns in this thesis are not risk adjusted, it is clear just by looking at the coefficients of each fund style that, on average, over the last ten years, small funds have performed better than mid-size funds as well as large funds. Contrary to the Fama-French Model, the coefficients in this regression analysis show that for this sample, growth funds outperformed value funds on average. This inconsistency could stem from

these returns not being risk adjusted but it could also be due to the rather small time period of only ten years that this thesis analyzes.

To expand on the analysis, the regression equation and coefficients from Panel D were used to calculate the average return and the impact that a change in predictor values would have on this number. Using each predictor's mean value, the average return was found to be 6.57 percent. As expected, simply changing the control year from 2014 to 2008 caused the average return to fall 45.69 percent to -39.12 percent. In addition, changing the control year to 2013, caused the average return to increase 26.36 percent. Consistent with the negative one to one relation that was found earlier, a change in the expense ratio from its mean value of 1.13 to its 95^{th} percentile value of 1.90 caused a decrease in the average return of approximately 0.72 percent. Furthermore, increasing the average beta from 1.08 to its 95th percentile value of 1.53 caused a slightly larger decrease in the average return of 1.61 percent.

The high R-squared in both Table 5 and 6 suggests that market forces are the main determinant of equity fund returns in any given year. The seemingly lacking relationship between log of turnover and returns is also evident through the insignificance of the coefficient of log of turnover in Table 6. Through the regression analysis and supplementary calculations, it appears that log of turnover has neither a positive nor negative relationship with equity fund returns.

Regression Analysis on Equity Fund Standard Deviation

The second regression analysis completed was that of equity fund standard deviation. The four panels to follow tell a very similar story to that of portfolio turnover's effect on equity fund returns.

Panel A of this regression analysis, in Table 7, shows the regression equation including only the constant and log of turnover. Here, both predictors are found to be statistically significant with a p-value of 0.000. For every increase of one in log of turnover, standard deviation only increases by 2.1633 percent. These variables only explain about 2.2 percent of the model's variability.

Table 7. Panel A

Predictor	Coefficient	P-value
Constant	11.3546	0.000
Log of Turnover	2.1633	0.000
R-Sq = 2.2%		

In Panel B of the regression analysis, shown in Table 8, the regression equation is expanded to include the expense ratio and beta. All variables remain statistically significant with p-values less than 0.05. The effect that log of turnover has on standard deviation has decreased by half since Panel A. Not surprisingly, beta has a positive relation to standard deviation causing it to increase by about 7 percent for every increase of 1 in beta. The addition of these variables has caused the R-squared to increase to 10.7 percent.

Table 8. Panel B

Predictor	Coefficient	P-value
Constant	4.1899	0.000
Log of Turnover	1.2498	0.000
Expense Ratio	0.6429	0.000
Beta	7.3876	0.000
R-Sq = 10.7%		

In an attempt to gain further insight into the relationship between log of turnover and standard deviation within equity funds, the years between 2004 and 2014 are added to the regression equation shown in Panel C in Table 9. Interestingly enough, each variable is statistically significant except for log of turnover. The effect beta has on standard deviation has continued to increase since Panel B. The volatility caused by the financial crisis is clear through the large coefficients of years 2008, 2009, and 2010; each of these years causes a notable increase in standard deviation. In this panel, the R-squared has increased to 94.1 percent. Identical to the previous regression analysis conducted on log of turnover and returns, it seems that market forces have the largest impact on the standard deviation of equity funds.

Table 9. Panel C

Predictor	Coefficient	P-value
Constant	-2.16914	0.000
Log of Turnover	0.00033	0.990
Expense Ratio	0.56269	0.000
Beta	11.4973	0.000
2004	-1.34317	0.000
2005	-0.90715	0.000
2006	-3.74672	0.000
2007	0.93128	0.000
2008	14.3742	0.000
2009	13.5568	0.000
2010	10.5096	0.000
2011	8.11946	0.000
2012	1.49647	0.000
2013	-0.26200	0.000
R-Sq = 94.1%		

Finally, Panel D, shown in Table 10, adds the fund styles to the regression equation. While it seems log of turnover has a negative relationship with standard deviation, it is important to notice that it is still the only variable that is insignificant with a p-value of 0.483. The coefficients of the variables included in the regression equation remain relatively unchanged since Panel C, thus telling that the incorporation of fund styles adds little value. Moreover, each fund style has a relatively small coefficient, therefore reaffirming that the impact fund style has on standard deviation is minimal. Further emphasizing this idea is the slight increase in R-squared. The inclusion of the fund styles only causes a 0.4 percent raise in the R-squared since Panel C. Once again, all evidence from the regression analysis points to the idea that market movements have the largest impact on the standard deviation of equity funds.

Table 10. Panel D

Predictor	Coefficient	P-value
Constant	-1.54317	0.000
Log of Turnover	-0.01854	0.483
Expense Ratio	0.37306	0.000
Beta	10.6448	0.000
2004	-1.24125	0.000
2005	-0.83781	0.000
2006	-3.57247	0.000
2007	0.85759	0.000
2008	14.3730	0.000
2009	13.4710	0.000
2010	10.4537	0.000
2011	8.13704	0.000
2012	1.47850	0.000
2013	-0.33996	0.000
Small Value	1.59145	0.000
Small Blend	1.23385	0.000
Small Growth	1.25563	0.000
Mid Value	0.77022	0.000
Mid Blend	0.53645	0.000
Mid Growth	0.64701	0.000
Large Value	0.31509	0.000
Large Growth	0.18893	0.000
R-Sq = 94.5%		

Using the mean value of each predictor and the coefficients from Panel D, the average standard deviation was calculated to be 10.32 percent. Simply changing the control year from 2014 to 2008 caused the standard deviation to increase significantly by 14. 37 percent to 24.7 percent. In addition, switching the control year to 2009 caused standard deviation to increase to 23.79 percent. Other variables such as fund style and expense ratio had little to no impact on the standard deviation. Selecting small value to be the control fund style instead of large blend, in order to test the effect that a considerably risky investment can have on the variation of returns, only caused the standard deviation to increase by 1.59 percent to 11.91 percent. Furthermore, hypothesizing that a fund has an expense ratio of zero generated a mean standard deviation of

9.91 percent. A one percent increase in expense ratio only led to a 0.37 percent increase in standard deviation.

Throughout this regression analysis it becomes very obvious that market forces are the main driver of changes in standard deviation. This relation is well demonstrated in the box plot in Figure 11 below. The inclusion of the years into the regression equation causes the R-squared to jump to an impressive 94 percent. From Panel C to D, the consistency of the coefficient values for each predictor demonstrates once again that the addition of fund styles adds minimal importance. The inadequate relation between portfolio turnover and standard deviation is especially evident beginning in Panel C, where log of turnover is no longer considered statistically significant. The regression analysis and further computations seem to imply that portfolio turnover has no relationship with standard deviation in equity funds, causing it to neither increase nor decrease.

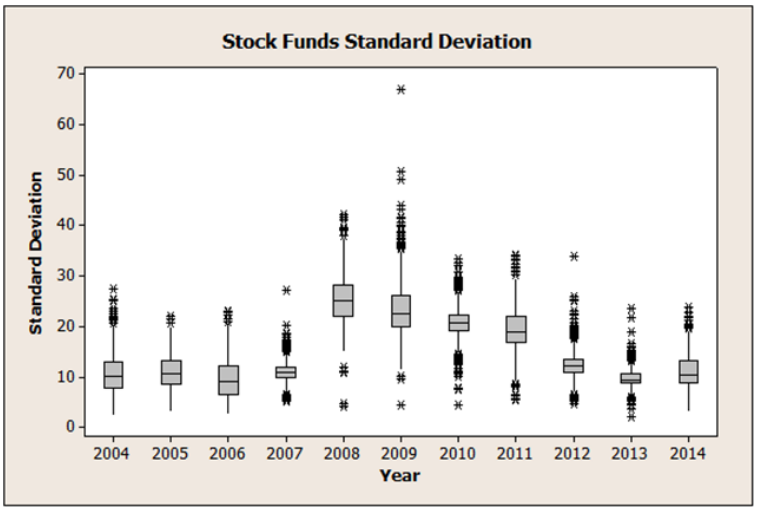

Figure 11. Equity Fund Standard Deviation

Chapter 6

Regression Analysis on Bond Funds

Regression Analysis on Bond Fund Return

The second group of regression analyses completed was that of bond funds. The regression analyses for equity funds and bond funds were separated to see if there was a difference in how portfolio turnover impacts fund returns and standard deviation depending on the underlying assets of the fund. In addition, much of the past research conducted on this topic excludes bond funds entirely or includes them in a sample intermingled with equity funds. In the following regression, it appears that the relationship between portfolio turnover and returns in bond funds is very different than that of equity funds.

Panel A of this regression analysis, shown in Table 11, includes only the constant and log of turnover. Here, log of turnover is found to be statistically insignificant with a large p-value of 0.203. In addition, this regression does not explain any of the models variability with an R-squared of zero percent.

Table 11. Panel A

Predictor	Coefficient	P-value
Constant	4.3588	0.000
Log of Turnover	0.1887	0.203
R-Sq = 0.0%		

In Panel B, shown in Table 12, the regression includes not only log of turnover, but expense ratio and beta, calculated relative to the Barclay's U.S. Aggregate Bond Index, as well.

Log of turnover remains statistically insignificant with an even large p-value than before of 0.289. Similar to Panel B of the equity fund return regression analysis, beta, measured relative to the bond index though, seems to have a negative relationship with returns. For an increase in beta of one, returns fall by 1.4622 percent. Unfortunately, the addition of two variables to the regression only increased R-squared to 1.3 percent.

Table 12. Panel B

Predictor	Coefficient	P-value
Constant	4.9418	0.000
Log of Turnover	0.1568	0.289
Expense Ratio	0.7298	0.002
Beta	-1.4622	0.000
R-Sq = 1.3%		

Panel C, shown in Table 13, continues to expand on the regression by including a ten year time period from 2004 to 2014. Log of turnover remains insignificant while beta becomes insignificant. In addition, year 2004 and 2006 are found to be statistically not significant. Surprisingly enough, expense ratio exhibits an almost one to one positive relationship with returns. For every increase of one percent in expense ratio, returns are said to increase by 0.8324 percent. A clear sign of the financial crisis, returns in 2008, relative to the year 2014, decreased by over eleven percent. In addition, returns in the year 2009, relative to the year 2014, increased by almost twelve percent; likely a depiction of the recovery following the stock market crash. The inclusion of the years causes the R-squared to increase to 41.4 percent. While this is a tremendous jump from Panel B, it is not as notable as the regressions done on equity funds where the R-squared reached over ninety percent.

Table 13. Panel C

Predictor	Coefficient	P-value
Constant	4.0993	0.000
Log of Turnover	0.1909	0.094
Expense Ratio	0.8324	0.000
Beta	-0.0432	0.672
2004	-0.4683	0.130
2005	-2.3840	0.000
2006	0.0179	0.949
2007	-1.0504	0.000
2008	-11.0220	0.000
2009	11.9664	0.000
2010	0.8286	0.002
2011	1.7389	0.000
2012	2.6144	0.000
2013	-6.4235	0.000
R-Sq = 41.4%		

In Panel D, shown in Table 14, the fund styles are added to the regression in order to expand upon it. Here, the fund style low moderate, one with low credit quality and moderate interest rate sensitivity, is used as the control. Log of turnover, 2004, and 2006 remain statistically insignificant. In addition, expense ratio, low extensive, and high extensive become insignificant. Beta has become statistically significant and again exhibits a negative relationship with fund returns. Although one would expect an increase in one of beta to augment returns, it seems to be doing the opposite with a coefficient of -0.3992. This could be due to the inclusion of the financial crisis in the ten year time sample, likely skewing the overall return data to be more severely negative than positive. Continuing the trend from Panel C, years 2008 and 2009 continue to display the crash of the stock market, its subsequent recovery, and its impact on returns. Adding the fund styles to the regression only causes the R-squared to increase by approximately 2 percent to 43.3 percent; thus showing that the style of a fund does not impact bond fund returns significantly.

Table 14. Panel D

Predictor	Coefficient	P-value
Constant	7.2362	0.000
Log of Turnover	0.0070	0.952
Expense Ratio	-0.1832	0.338
Beta	-0.3992	0.001
2004	-0.2269	0.458
2005	-2.2143	0.000
2006	0.1725	0.530
2007	-1.0278	0.000
2008	-10.9267	0.000
2009	11.9623	0.000
2010	0.9112	0.000
2011	1.7445	0.000
2012	2.6789	0.000
2013	-6.2913	0.000
Low Limited	-0.5712	0.028
Low Extensive	-0.4993	0.186
Medium Limited	-3.4017	0.000
Medium Moderate	-1.9140	0.000
Medium Extensive	-1.1891	0.000
High Limited	-3.7934	0.000
High Moderate	-2.2853	0.000
High Extensive	-0.3259	0.457
R-Sq = 43.3%		

Using the coefficients from Panel D and the calculated mean values, the average return was found to be 6.81 percent. Simply changing the control year from 2014 to 2008 caused the average return to plummet to -4.12 percent. Doing the same for the year 2009 caused the average return to escalate from 6.81 percent to over eighteen percent. As discussed above, it is expected that with an increase of one in beta, returns should grow as well, yet Panel D exhibits a negative coefficient for beta. To further explore this unexpected relationship, a comparison can be made between the mean beta of 0.75 and the 95th percentile beta of 1.66 and how it impacts returns. While the expectation is that it should increase returns significantly, it actually causes returns to fall 0.36 percent from 6.81 percent to 6.45 percent.

With log of turnover remaining statistically insignificant from Panel A to Panel D, it is clear that portfolio turnover does not have a significant impact on bond fund returns. In addition, the rather low R-squared of 41.4 percent in Panel C shows that market forces slightly affect returns but are not the main determinant of bond fund performance. Furthermore, the slight increase of 2 percent in the R-squared from Panel C to Panel D demonstrates that fund style has almost no relationship with returns. Through the regressions and further calculations, it becomes obvious that portfolio turnover does not affect bond fund returns and neither does fund style. With the highest R-squared being only 43.3 percent, in Panel D, it seems that this thesis has not found a variable that significantly impacts returns, although one may exist.

Regression Analysis on Bond Fund Standard Deviation

The second regression analysis completed for bond funds was that of their standard deviation. Although very similar to the previous bond fund analysis, the impact that market forces and fund styles has on bond fund standard deviation is slightly more impressive than that found between those same variables and bond fund returns.

In Panel A, show in Table 15, the analysis simply uses the constant and log of turnover in an attempt to better understand movements in standard deviation, although without much success. Here, log of turnover is found to be statistically insignificant with a p-value of 0.146. In addition, the R-squared is found to be 0.0 percent meaning that these variables explain none of the model's variability.

Table 15. Panel A

Predictor	Coefficient	P-value
Constant	4.3031	0.000
Log of Turnover	-0.08240	0.146
R-Sq = 0.0%		

Many changes occur from Panel A to Panel B in Table 16. Now, all of the variables are found to be statistically significant. With every increase in log of turnover by one, the standard deviation falls by 0.15431 percent. This is worth noting as it directly opposes the initial hypothesis made regarding the relationship between turnover and risk. Beta seems to exhibit an expected relationship as an increase of one in beta causes standard deviation to augment by 1.58564 percent. The R-squared has changed noticeably rising to 11.8 percent.

Table 16. Panel B

Predictor	Coefficient	P-value
Constant	1.8050	0.000
Log of Turnover	-0.15431	0.004
Expense Ratio	1.85460	0.000
Beta	1.58564	0.000
R-Sq = 11.8%		

Panel C, shown in Table 17, expands on the analysis by adding each year from 2004 to 2014 and using 2014 as the control. Here, log of turnover continues to become more and more statistically significant with a p-value of 0.000 now. Continuing to contradict the hypothesis made in the beginning of this thesis, log of turnover seems to show an even stronger negative relationship with standard deviation with a coefficient of -0.28887. In addition, beta continues to exhibit a positive relationship with standard deviation. Likely demonstrating the financial crisis, the coefficient for years 2008 and 2009 are 6.49737 and 4.19969 respectively. This shows that relative to the control year, 2014, 2008 and 2009 had much higher standard deviations.

Furthermore, the subsequent recovery of the market is presented through the small coefficients of the following years. Adding the ten year time sample to the regression analysis caused the R-squared to increase to 46.7 percent. Thus, showing that market forces do in fact have an impact on bond fund standard deviation, although not as impressive as the same relationship found within equity funds.

Table 17. Panel C

Predictor	Coefficient	P-value
Constant	0.2698	0.015
Log of Turnover	-0.28887	0.000
Expense Ratio	1.94377	0.000
Beta	1.78646	0.000
2004	1.0249	0.000
2005	0.2630	0.010
2006	-0.2267	0.025
2007	0.6657	0.000
2008	6.49737	0.000
2009	4.19969	0.000
2010	1.58507	0.000
2011	1.71031	0.000
2012	0.40425	0.000
2013	1.01310	0.000
R-Sq = 46.7%		

Panel D, shown in Table 18 adds bond fund styles in an attempt to discover which variable has the most significant impact on standard deviation. Here, each variable remains statistically significant except for the year 2006. The relationship between log of turnover becomes once again more severe with a coefficient of -0.53113. Again, the financial crisis and its eventual recovery is shown through the coefficients of years 2008, 2009, and so on.

One relationship worth noting in this regression analysis is that most of the bond fund styles exhibit a negative coefficient relative to the control style of low moderate. The only fund style to demonstrate a positive relationship with standard deviation is low extensive. Recalling

from the bond fund style box shown previously, low, medium, and high represent the credit quality and limited, moderate, and extensive depict the interest rate sensitivity. Using this information, one would likely assume that the fund with the highest credit quality and the lowest, limited, interest rate sensitivity would cause a significant decrease in risk, denoted by standard deviation. This can be seen in the regression analysis as the high limited bond fund style has a negative coefficient of 3.53765. Furthermore, one would also likely expect the bond fund with the worst credit quality, low, and the highest interest rate sensitivity, extensive, to have a positive relationship with standard deviation thus suggesting more risk. This is again the case as the low extensive fund style has a positive coefficient of 0.4982. The inclusion of bond fund styles has also increased the R-squared to 58.8%. Again, although this relationship is not as prominent as the one found within equity funds, it still suggests that bond fund styles do in fact have a slight impact on bond fund standard deviation.

Table 18. Panel D

Predictor	Coefficient	P-value
Constant	3.4843	0.000
Log of Turnover	-0.53113	0.000
Expense Ratio	0.88142	0.000
Beta	1.50042	0.000
2004	1.30488	0.000
2005	0.47385	0.000
2006	-0.03328	0.710
2007	0.73394	0.000
2008	6.62064	0.000
2009	4.24547	0.000
2010	1.68588	0.000
2011	1.74390	0.000
2012	0.47736	0.000
2013	1.12591	0.000
Low Limited	-0.58944	0.000
Low Extensive	0.4982	0.000
Medium Limited	-3.11399	0.000
Medium Moderate	-2.24876	0.000
Medium Extensive	-0.8494	0.000
High Limited	-3.53765	0.000
High Moderate	-2.47589	0.000
High Extensive	-0.4412	0.002
R-Sq = 58.8%		

In order to dive deeper into some of these relationships, the average standard deviation was calculated to be 4.3949 percent using the coefficients from Panel D and their respective mean values. Simply changing the beta from the mean value to the 5th percentile and then again to the 95th percentile value changes the average standard deviation from 3.0408 percent to 5.7574 percent, thus reinforcing the positive impact that beta has on risk. Continuing to reject the initial hypothesis that log of turnover would have a positive relationship with standard deviation is the difference in the standard deviation when changing the log of turnover variable from the 5th percentile value to the 95th percentile value. This slight change causes the standard deviation to fall almost one percent from 4.8144 percent to 3.9099 percent. The expected relationship

between standard deviation and bond fund style can also be further explored. Changing the control variable from low moderate to low extensive causes the standard deviation to rise to 4.8931 percent and again changing it to high limited forces the standard deviation to fall to -3.5376 percent.

As log of turnover remains statistically significant for much of this regression, it seems that it does in fact have an impact on bond fund standard deviation; although this negative relationship opposes the initial hypothesis of this thesis. But, it is important to notice that this relationship is minute compared to that of market forces and bond fund styles. Although not as prominent as the impact these variables had on equity fund standard deviation, it is in fact more impressive than the relationship between these variables and bond fund returns. The jump in R-squared from Panel B to C suggests that market forces do in fact cause bond fund standard deviation to change; this is further emphasized in the box plot in Figure 12. Finally, as the R-squared rises again from Panel C to D, it suggests that bond fund style also affects bond fund standard deviation. Overall though, the R-squared for this regression analysis tops off at 58.8 percent, suggesting that there may exist a variable, other than those included in this analysis, that has a more profound effect on bond fund standard deviation.

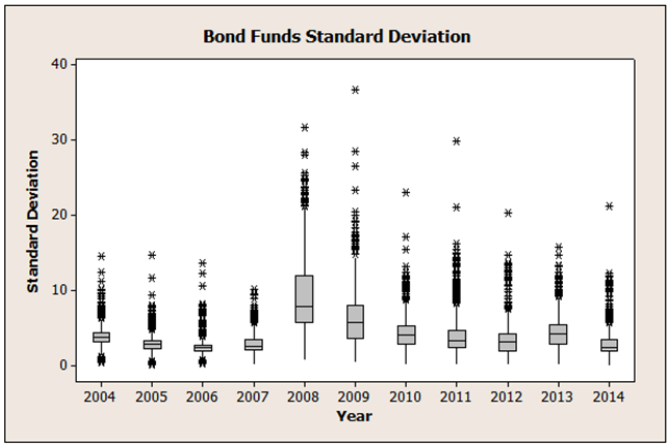

Figure 12. Bond Fund Standard Deviation

Chapter 7

Conclusion

The purpose of this thesis was to dive deeper into United States domiciled mutual funds in hopes to uncover a relationship between portfolio turnover and performance, measured by returns, as well as portfolio turnover and risk, measured by standard deviation. The research was conducted on a sample of 3,561 United States domiciled mutual funds with 2,223 investing solely in U.S. equities and 1,338 investing entirely in either municipal bonds or taxable bonds.

The analysis between portfolio turnover and performance was divided between equity funds and bond funds in an attempt to tie any relationship found to one single type of security. The following hypothesis was made prior to beginning the research:

> *Portfolio Turnover and Performance:* Portfolio turnover and performance will exhibit a negative correlation for all asset classes and investment strategies. This stems from the belief that higher portfolio turnover leads to increased costs and therefore lower returns for investors. In addition, it is unlikely that an increased portfolio turnover will cause portfolio managers to make superior asset selection decisions.

Within the sample of equity funds, this hypothesis was not proven as it was discovered that market forces seem to be the main determinant for equity fund returns. In addition, it appeared portfolio turnover has neither a positive nor negative relationship with equity fund performance as log of turnover was found to be statistically insignificant throughout most of the regression analysis. The outcome regarding bond funds was very similar. Log of turnover remained

statistically insignificant throughout each panel of the regression analysis suggesting that again, portfolio turnover has neither a positive nor negative relationship with bond fund returns. Furthermore, it appeared that fund style did not have a noteworthy impact on bond fund performance suggesting that another unexplored variable may exist that does in fact determine bond fund returns.

The research conducted on portfolio turnover and risk was also divided between equity funds and bond funds. Again, the following hypothesis was made prior to beginning the analysis:

> *Portfolio Turnover and Risk:* Portfolio turnover and risk will exhibit a positive correlation for all asset classes and investment strategies. This stems from the belief that a higher rate of portfolio turnover leads to a greater chance of mistake and therefore raises the risk that an investor faces.

Within equity funds, the hypothesis initially made was not able to be proven. Again, market forces seem to have the most impact on equity fund standard deviation. Once more, the statistical insignificance of log of turnover throughout the majority of the regression analysis suggests that portfolio turnover has neither a positive nor negative relationship with equity fund risk. The result regarding bond funds is a bit more telling though. While the initial hypothesis made was not supported through the research, it appears a negative relationship was found between portfolio turnover and bond fund risk. Log of turnover remained statistically significant throughout the regression analysis with a negative coefficient. Although it appears portfolio turnover may have a negative relationship with bond fund standard deviation, the relatively low R-squared of 58.8 percent suggests that once again an unexplored variable may also have a large impact on bond fund risk.

Implications of Research Findings

As said previously, the relationship between portfolio turnover and risk, measured throughout this thesis by standard deviation, appears to remain unresolved. In equity funds it was found to be neither positive nor negative and while the regression for bond funds suggested a negative relationship, the R-squared implied that another unknown variable may have a larger impact on risk. This suggests that when individual investors are attempting to analyze their potential investment risk they should focus not on standard deviation but instead on more obvious items such as fund style. In bond funds, for example, this thesis found that the high limited bond fund style, one with excellent credit quality and low interest rate sensitivity, did in fact have a negative relationship with risk. On the other hand, the low extensive fund style depicting poor credit quality and high interest rate sensitivity had a positive relationship with risk. Therefore, a risk averse investor may want to avoid funds that are categorized as being less attractive and invest in those with better credit quality ratings and low sensitivity to interest rate changes.

The relationship between portfolio turnover and returns found in this thesis suggested that market forces and other unidentified variables, instead of portfolio turnover, have the most profound impact on fund performance. It is important to recognize though that an abundance of research has in fact found that in addition to market forces driving fund returns, portfolio turnover also has an effect on performance.

When comparing actively managed funds to index funds, one must recognize that every transaction comes at a cost and therefore, funds with higher portfolio turnover must perform

even better than funds with low turnover in order to cover the additional costs they incur and still come out on top. In Phillips et al. (2014), it was found that on average, actively managed funds were unable to outperform their benchmarks after accounting for their high costs. In addition, while index funds also often underperform their own benchmarks, Phillips et al. (2014) discovered that low-cost index funds have a greater chance of outperforming their high-cost actively managed counterparts. Therefore, while an investor might expect a low-cost active fund to outperform its high-cost equivalent, both are actually likely to be outperformed by a low-cost index fund that is often able to achieve even lower costs than any active fund available. Figure 13 clearly depicts this relationship between portfolio turnover, incurred costs, and performance (Solin, 2015). Consequently, it may be in an individual's best interest to invest in a low-cost index fund that may not consistently outperform its market benchmark but does in fact provide an inexpensive well diversified investment opportunity that will likely outperform most actively managed funds.

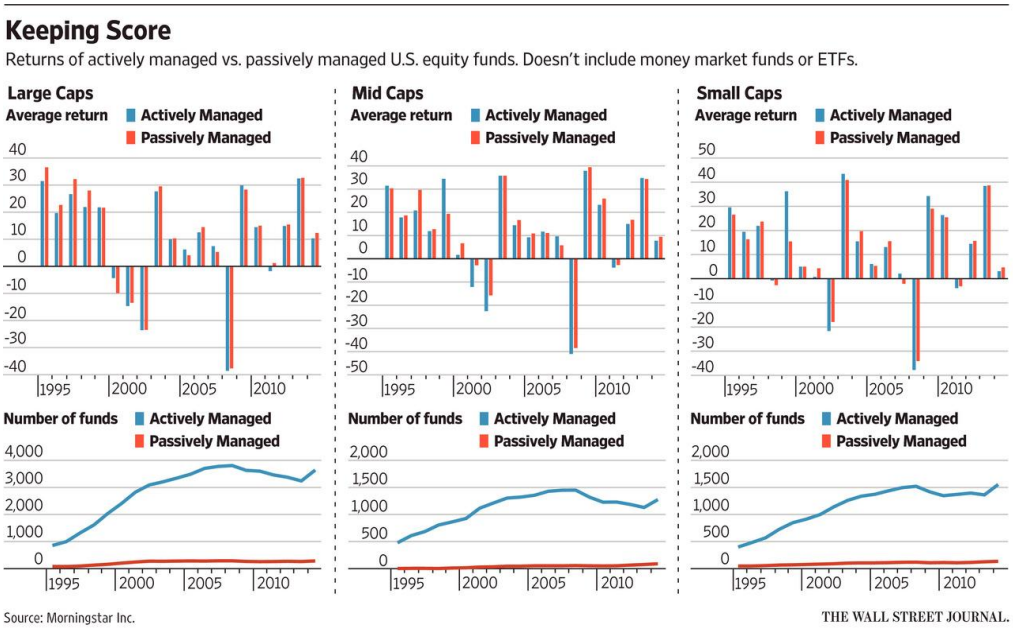

Figure 13. Performance of Actively vs. Passively Managed Funds

Potential Ideas for Further Research

A few obvious changes can be made to this research in an attempt to discover a relationship that was not able to be found within this thesis. Additional analysis on this topic could be conducted on a larger sample that includes both domestic and international mutual funds. Furthermore, the same research could be performed strictly on international markets. The length of the time period of collected data could also be amended by either shortening or lengthening it. One could make a conscious effort to investigate a time period that does not include any financial crises in order to eliminate the possibility of this market change impacting mutual fund return and standard deviation data. In addition, one could choose to not divide the research between equity funds and bond funds and instead simply analyze the relationship in a sample of mutual funds that are invested in both types of securities. Finally, if one could hypothesize what the unknown variable is that impacts both bond fund returns and risk, its inclusion in the regression analyses could uncover a hidden relation with portfolio turnover.

Appendix A

Additional Figures

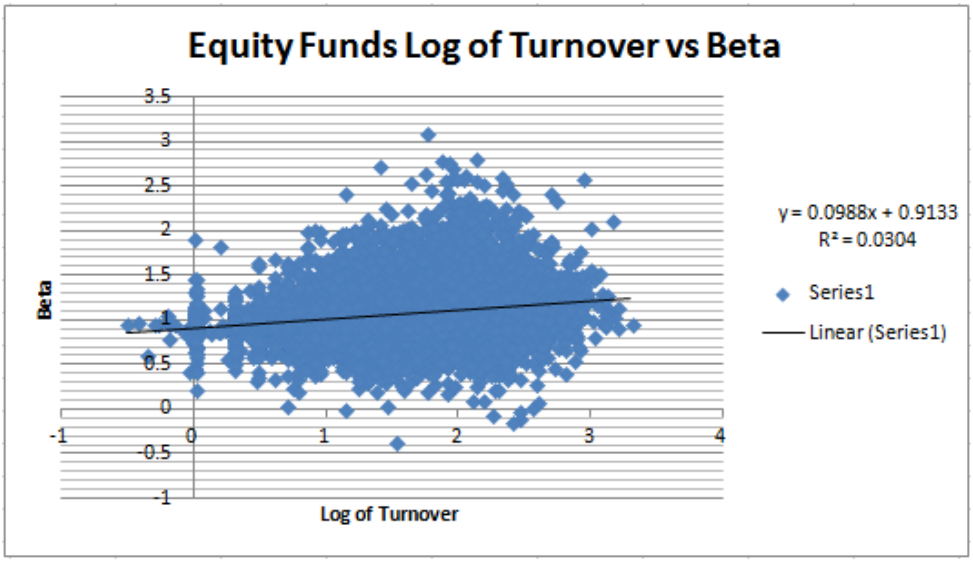

Figure 14. Equity Funds Log of Turnover vs. Beta

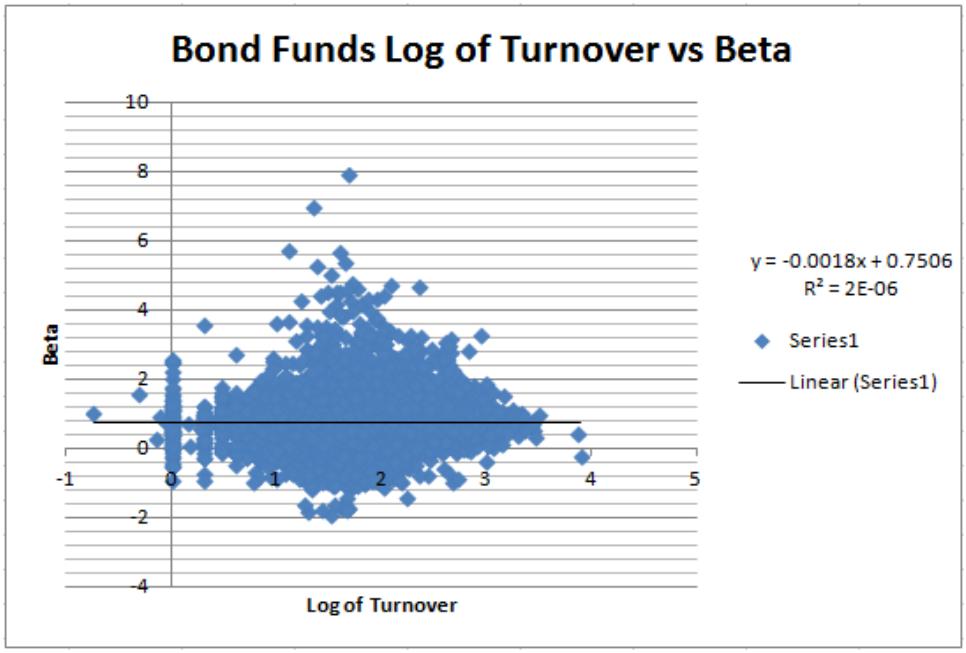

Figure 15. Bond Funds Log of Turnover vs. Beta

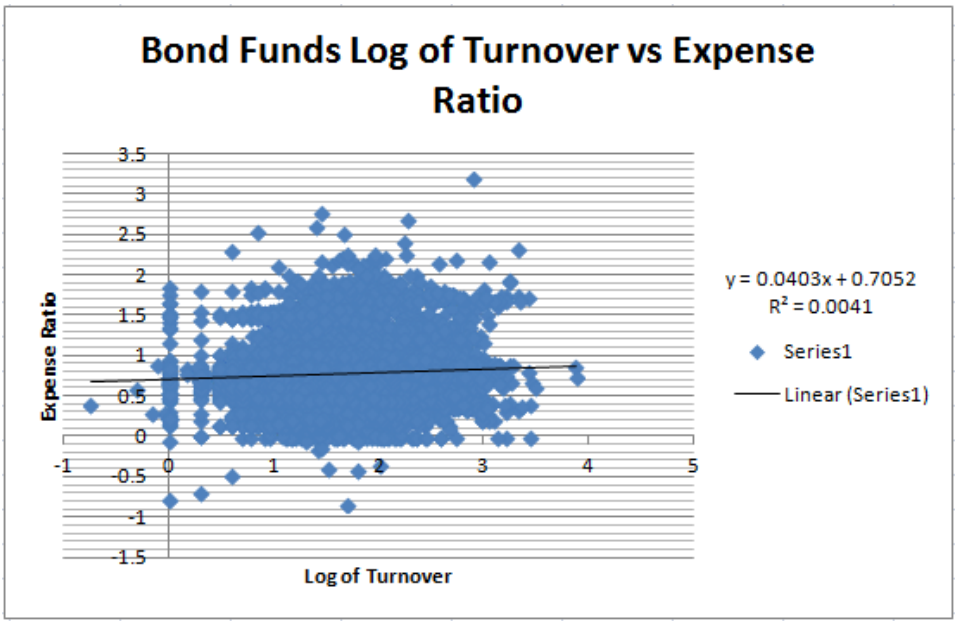

Figure 16. Bond Funds Log of Turnover vs. Expense Ratio

BIBLIOGRAPHY

"Advisory Note "Bias in Science Publishing"" *ICSU*. International Council for Science, 1 . 2011. Web. 28 Sept. 2015. <http://www.icsu.org/publications/cfrs-statements/bias-in-science-publishing>.

Barber, B. M., & Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. The Quarterly Journal of Economics, 116(1), 261-292.

Barber, B. M., & Odean, T. (2000). Trading is hazardous to your wealth: The common stock investment performance of individual investors. Journal of Finance, 55(2), 773-806.

Barr, C. (2015, September 21). The New Bond Market: Bigger, Riskier and More Fragile Than Ever. *The Wall Street Journal*. Retrieved September 28, 2015, from http://www.wsj.com/articles/the-new-bond-market-bigger-riskier-and-more-fragile-than-ever-1442808001

Carhart, M. (1997). On persistence in mutual fund performance. Journal of Finance, 52(1), 57-82.

Edelen, R., Evans, R., & Kadlec, G. (2013). Shedding light on "invisible" costs: Trading costs and mutual fund performance. *Financial Analysts Journal*, *69*(1), 33-44. Retrieved from http://search.proquest.com/docview/1352857721?accountid=13158

Grinblatt, M., & Titman, S. (1994). A study of monthly mutual fund returns and performance evaluation techniques. Journal of Financial and Quantitative Analysis, 29(3), 419-444.

Ippolito, R. A. (1989). Efficiency with costly information: A study of mutual fund performance, 1965-1984. The Quarterly Journal of Economics, 104(1), 1-23.

Khorana, A. (1996). Top Management Turnover: An Empirical Investigation of Mutual Fund Managers. Journal of Financial Economics, 40, 403-427.

Morningstar Style Box. (n.d.). Retrieved August 10, 2015 from http://www.morningstar.com/InvGlossary/morningstar_style_box.aspx

Philips, C. B., Kinniry, F. M., Jr., Schlanger, T., & Hirt, J. M. (2014). The Case for Index-Fund Investing. *Vanguard*. Retrieved January 23, 2016, from https://pressroom.vanguard.com/content/nonindexed/Updated_The_Case_for_Index_Fund_Investing_4.9.2014.pdf

Rumsey, D. (2011). Chapter 5: Means, Medians, and More. In *Statistics For Dummies* (2nd ed., pp. 81-83). Hoboken, New Jersey: Wiley Publishing.

Solin, D. (2015, March 1). Is There a Case for Actively Managed Funds? The Wall Street Journal. Retrieved January 23, 2016, from http://www.wsj.com/articles/are-index-funds-really-better-than-actively-managed-1425271058

Tang, K. (n.d.). Bond Market Size Vs. Stock Market Size. Retrieved September 28, 2015, from http://finance.zacks.com/bond-market-size-vs-stock-market-size-5863.html

The Fama-French Three-Factor Model. (n.d.). Retrieved October 22, 2015, from http://portfoliosolutions.com/latest-learnings/fama-french-three-factor-model

Tucker, M. (2011, September 13). Q&A on Bond Funds and Churn: Why turnover can be misleading. Retrieved August 12, 2015, from http://www.blackrockblog.com/2011/09/13/qa-on-bond-funds-and-churn-why-turnover-can-be-misleading/

Turnover Ratio. (n.d.). Retrieved March 12, 2015, from http://www.morningstar.com/invglossary/turnover_ratio.aspx

Wu, S. (2014). Interaction between Mutual Fund Performance and Portfolio Turnover. Journal of Emerging Issues in Economics, Finance and Banking (JEIEFB), *3*(4).

Academic Vita

Aurélie Denis
axd5266@psu.edu

EDUCATION:

The Pennsylvania State University
Schreyer Honors College **University Park, PA**
Smeal College of Business **May 2016**

- Major: Finance
- Minor: Economics
- Twice recipient of Evan Pugh Scholar Award: awarded to students in top 0.5 percent of class
- 2015-2016 Sam Wherry Honors Scholarship in the Smeal College of Business recipient
- 2014-2015 Horowitz Scholarship for Schreyer Scholars recipient

---

LEADERSHIP:

Penn State Finance Society **University Park, PA**
Market Analysis Group Managing Editor **Aug 2013 - Dec 2015**

- Responsible for the weekly publication of the only financial review website at Penn State
- Organized the first-ever Penn State Seeking Alpha Stock Pitch Competition which hosted students from around the country
- Network with corporations and volunteer to support charities

Lion Scouts **University Park, PA**
Financial Coordinator, member of Constitution Committee, and Tour Guide **Oct 2012 - Jan 2015**

- Performed accounting for the organization
- Guided prospective students through tours and provided community service

---

WORK EXPERIENCE:

The Vanguard Group **Malvern, PA**
Investment Strategy Group Intern **May - July 2015**

- Created a new SharePoint site intended as a repository for research conducted between the Investment Strategy Group and Vanguard Institutional Advisory Services
- Organized the July event for Women's Initiative for Leadership Success, a Vanguard Resource Group
- Collaborated with Vanguard professionals to conduct extensive research in support of my Penn State Schreyer Honors College thesis
- Aided in the creation and editing of slide decks and white papers used for external distribution
- Networked with various Vanguard leaders within and outside of the Investment Strategy Group

Owens-Illinois **Perrysburg, OH**
Financial Leadership Development Program Intern **June - Aug 2014**

- Tested procurement card and travel and entertainment controls
- Performed SAP application controls for the IT audit department as provided by Ernst & Young
- Travelled to Oakland, CA to perform a full scope audit at a glass container manufacturing plant
- Analyzed forecasts, budgets, invoices, and other items for the North American finance department
- Networked with O-I leaders within and outside of the internal audit and finance departments

---

SKILLS:

Fluent in French
Working towards proficiency in Spanish

- 5 years of Spanish and participant in a Spanish study abroad program **2009 - 2010**

INTERNATIONAL EXPERIENCE:

3 relocations between the USA and Belgium and frequent domestic and international travels