Asset Pricing Models and Portfolio Selection: 
A Pragmatic Approach*

Rafael Dantas Guimarães†
José Guilherme Lara Resende‡

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Abstract
The study of asset pricing models is typically motivated by the observation of pricing anomalies and is directed towards mathematical and econometric methods and techniques to explain future prices or expected returns. Such methods and techniques are generally applied to portfolios based mostly on theoretical concerns. We focus on portfolios which were assembled according to guidelines used by successful investors that could actually be traded in stock markets. These portfolios are evaluated by the CAPM and the Fama-French 3-factor model (FF3F) (Fama and French, 1996). The results not only confirm the FF3F model’s greater explanatory power in comparison with the CAPM but also show that expected returns resulting from the growth investing philosophy are better explained by these two models than the expected returns resulting from the value investing philosophy.

Keywords: Investment, Portfolio Management, Asset Pricing.

JEL classification: G11, G12, G14

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†Government of Singapore Investment Corporation. E-mail: rgdantas@gmail.com
‡Universidade de Brasília, campus universitário Darcy Ribeiro, caixa postal 04587, Brasília, DF. E-mail: jghresende@gmail.com
1 Introduction

The present study expands the understanding of asset pricing models by inverting the usual procedure of studies in this field. We assemble five portfolios using the guidelines of five famous investors described by Reese and Forehand (2009) and then evaluate these portfolios using the Capital Asset Pricing Model (CAPM) and the Fama and French’s 3-factor model (FF3F) (Fama and French, 1996).

The development of asset pricing models and quantitative finance is subject to contributions from many different fields. Asset prices are influenced by a possibly intractable number of variables, surrounded by uncertainty and subject to incomplete sampling. Therefore, the examination of investor behavior can be helpful for a better understanding of asset prices.

Markowitz (1952) argued that assets’ expected returns should not only reflect their own risk (variance), because part of this risk could be diversified away. Therefore, expected returns should reflect only risk that is non-diversifiable, associated to a systematic risk, that affects the entire market (and, therefore, also called market risk). This notion led to the first asset pricing equilibrium model, the Capital Asset Pricing Model (CAPM), independently developed by Sharpe (1964), Lintner (1965), Mossin (1966) and Treynor (1961, 1962).

The CAPM model was gradually questioned. Two major methodological critiques were made by Roll (1977), and Hansen and Richard (1987). Roll (1977) argued that the CAPM is a tautology, since it is always valid, provided that the proxy used for the market return is efficient in the sense of Markowitz. Since the market portfolio is not observable, tests of the CAPM are only tests of the market proxy adopted. Hansen and Richard (1987) showed that the CAPM is a conditional model, and that most tests were performed as if the model were valid unconditionally. Since it is impossible to collect all information observed by investors, it is not possible to fully test conditional models like the CAPM.

A different class of critique to the CAPM arises from its lack of explanatory power in certain situations, called anomalies. Examples are the January effect (Banz, 1981; Moller and Zilca, 2008), the size effect (Roll, 1981; Reinganum, 1981), the momentum effect (Jegadeesh and Titman, 1993; Asem, 2008), and the reversal effect (DeBondt and Thaler, 1985), among others.

These shortcomings advanced alternative models. The Arbitrage Pricing Theory (APT) (Ross, 1976) provided a model for expected returns based only on arbitrage considerations. The intertemporal CAPM – ICAPM (Merton, 1973) provided an equilibrium model with several factors. There was a search for models that would perform well, better explaining expected returns and accommodating the anomalies associated with the CAPM.

Fama and French (1996) proposed a model that can be viewed either as an APT or an ICAPM, where expected returns are determined by three factors: the market return, the SMB factor (“small minus big” factor, which reflects the excess return of small companies over big companies) and the HML factor (“high minus low” factor, which reflects the excess return of companies with high book-to-market over companies with low book-to-market).
Fama and French showed that their model is significantly more powerful than the CAPM in explaining expected returns in the U.S. stock market. The Fama-French 3-factor (FF3F) model still is a benchmark in the field of asset pricing.

Asset pricing models are usually tested on portfolios of heterogeneous assets (Fama and French, 1996; Lettau and Ludvigson, 2001; Grauer and Janmaat, 2008; Asem, 2008). Fama and French (1996), for example, test the CAPM and their 3-factor model for the American stock market, based on 25 portfolios built using two relatively simple criteria: size and book-to-market ratios. The focus of Fama and French (1996) and other similar studies was on testing a particular theoretical model, with little regard to using portfolios that are actually traded on the market.

The sheer idea of asset pricing models indicating mispricings and market failures suggests a need for a more pragmatic approach. Portfolios that are traded on the market involve many variables, not just prices and book values. The novelty of our study is the construction of portfolios that follow guidelines used by famous investors, as described by Reese and Forehand (2009). We invert the traditional approach in the asset pricing literature by first building portfolios that could be traded on the market and then checking how these portfolios perform under two key asset pricing models, the CAPM and the Fama-French 3-factor (FF3F) model.

Our results show that portfolios built following the *growth investing* philosophy are better explained by the CAPM and the FF3F model than those built following the *value investing* philosophy. We also show that the portfolio built following the guidelines underlined for Warren Buffett’s investment strategy performs best, in terms of highest expected return, after controlling for risk. We interpret these results as an alternative way of evaluating two fundamental asset pricing models, using portfolios built to resemble strategies used in the market. That is, we provide a strong connection between the theoretical development and the practical application of these two models.

The remainder of the paper is organized as follows: section 2 discusses our methodology and software designed to collect the data used; section 3 presents the five portfolios built and discusses the individual investor strategy that motivates each portfolio; section 4 evaluates these five portfolios using the CAPM and the FF3F model, and computes several measures of performance; and section 5 presents our conclusions.

2 Methodology

Reese and Forehand (2009) provided objective and computationally implementable criteria for building portfolios based on guidelines from famous investors. Investment strategies such as those from Benjamin Graham and Warren Buffett were translated into mathematical instructions that allow the selection of assets based on the balance sheet information of firms with publicly traded stocks. We obtained this balance sheet data from Yahoo! Finance\(^1\). We filtered these data according to the strategy used by each investor, building a

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\(^1\)http://finance.yahoo.com.
portfolio that mirrors their investment policies. For this purpose, we built a software that automatically gathers information from companies with publicly traded stocks which generated five portfolios that emulate the investment strategies of five famous investors, following the rules underlined by Reese and Forehand (2009).

The software was written in C# language, so as to overcome the absence of a free and widely available database containing not only stock prices, but also balance sheet information on companies with publicly traded stocks. Starting from a list of stock tickers of companies with stocks traded on the New York Stock Exchange (NYSE) and on the National Association of Securities Dealers Automated Quotations (NASDAQ), the software then collected the balance sheet information at Yahoo! Finance. For each company, the software loaded its respective page and captured from the source code its balance sheet information. For each stock, the software obtained 68 pieces of information. After searching all 5,198 companies listed in both stock exchanges, the software returned a complete database.

After this step, the software independently applied five sets of filters to the database. Each set of filters was programmed according to guidelines established by Reese and Forehand (2009) that represent the investment styles of Benjamin Graham, John Neff, Warren Buffett, Peter Lynch and Kenneth Fisher. For a company to enter one of these portfolios, all variables should necessarily pass through the respective portfolio filter. If the value of any single variable was outside the allowed range it was excluded from the portfolio.

Once all five portfolios were generated, the software then performed its final task of capturing at Yahoo! Finance the historical monthly series of prices for each asset of each portfolio. For each month, the software looked for the average price of each asset in each portfolio and then calculated the average of these prices, with equal weights, in order to obtain the price for that portfolio in that month. With all the monthly prices for the five portfolios, the computation of the monthly return for each portfolio was simple.

We decided to use equal weights because Reese and Forehand (2009) did not specify what weights should be used. In the absence of a clear choice for weights, equal weights seemed a natural choice. We also opted to use pricing data from Yahoo! Finance instead of the databases commonly used in academic studies (CRSP or COMPUSTAT) in order to be consistent with the balance sheet data used, which was also collected from Yahoo! Finance.

The final database contained, for each portfolio, the monthly return for the period under study. To the database we then added the factors used to apply the CAPM and the FF3F model, obtained from Kenneth French’s online library.

Once these portfolios were constructed, they were evaluated using the CAPM and the FF3F model. For each portfolio we computed the expected return according to these two models. The methodology is similar to the one used by Fama and French (1996) and consists of estimating the betas for each portfolio. We use the 1-month treasury bond as the risk-free asset, obtained from Kenneth French’s online library, and the Dow Jones index as the market return. With these proxies, common in the literature, we estimated the two

\[\text{http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.}\]
models' coefficients running an OLS regression on SAS for each portfolio and model, in a total of 10 regressions.

We then computed the expected return of the portfolios according to the CAPM and the FF3F model, and the $R^2$ of these two models for each portfolio. We evaluate the divergence between the expected and observed returns using several measures: Jensen’s Alpha, Treynor Ratio, Sharpe Ratio, Sortino Ratio, and Sortino-Satchell Ratio.

The analysis of the anomalous expected returns measures and the $R^2$ provides an assessment of the performance of each investment strategy, measured by the information entailed in the portfolio associated to that strategy. It also provides insights about what investment style is better explained by these two models. Therefore, as we discussed in the introduction, this study sheds light on the practical application of asset pricing models, since it uses portfolios that resemble the ones traded by investors on the stock market.

3 Portfolio Composition

The portfolios built are formed by stocks negotiated at the NYSE and the NASDAQ. The data was obtained from Yahoo! Finance and aggregated by the software described in the previous section, which selected 5,198 stocks on January 18, 2010. We obtained the benchmark returns for the CAPM and the FF3F model from Kenneth French’s online library.

The software built this asset database in the following way. For each stock, the software searched for its respective page on Yahoo! Finance, found its balance sheet information, and added this information to the database. Then the complete database was filtered according to the rules described by Reese and Forehand (2009) in order to generate the portfolios.

The database and the filters delivered 5 portfolios\(^3\), each based on the recommendations of a famous investor. Reese and Forehand (2009) describe investment guidelines of 10 successful investors, but we only selected 5 of these, since all 10 could be considered representative of the two investment styles. The first, value investing, focuses on larger companies, brand value, low prices and less risk. The second, growth investing, focuses on smaller companies, more risk and higher potential growth. Benjamin Graham, John Neff and Warren Buffet are considered value investors. Peter Lynch and Kenneth Fisher are considered growth investors. The criteria for the choice of these investors and their respective guidelines are described in the subsequent subsections, and are based on Reese and Forehand (2009).

\(^3\)See Appendix A.
3.1 Benjamin Graham (1894 - 1976)

Benjamin Graham is a pioneer of value investing. His historical annual return averaged 20% between 1936 and 1956, while the market average was 12.2% for the same period. Graham was one of history’s greatest investors and his investment strategy aimed at lower risks and capital preservation. His portfolios featured assets from companies that had what he called margin of safety: a significant difference between the market price and the company’s real value.

Reese and Forehand (2009) translated Graham’s investment strategy into quantitative rules and suggested the guidelines below, which we used to build the BG portfolio. The software returned a portfolio of 13 assets. The guidelines underlined by Reese and Forehand (2009) are:

- Do not include technology companies;
- Sales equal to or greater than US$ 340 million;
- Current ratio (current assets over current liabilities) equal to or greater than 2 (for public utilities or telecommunications companies, this ratio can be less than 2);
- Long run debt less than or equal to the net current assets (current assets minus current liabilities);
- EPS (earnings per share) growth equal to or greater than 30% in the last 5 years and no negative annual value;
- PE (price to earnings) less than or equal to 15;
- PB (price to book) ratio times PE ratio less than or equal to 22;
- DE (debt to equity) ratio less than or equal to 100% (230% for public utilities or telecommunications companies).

3.2 John Neff (1931 - )

John Neff is another example of a successful value investor. His historical annual return between 1964 and 1995 averaged 13.7%, while the market average was 10.6% in the same period. Like Graham, Neff directs his investments towards preserving capital. His focus was on companies with a recent history of difficulties and low prices, which were then filtered according to a set of quantitative indicators.

Reese and Forehand (2009) translated Neff’s investment strategy into quantitative rules and suggested the guidelines below, which we used to build the JN portfolio. The software returned a portfolio of 27 assets. The guidelines underlined by Reese and Forehand (2009) are:

- PE ratio less than or equal to 60% of the market average and equal to or greater than 40% of the market average;
• EPS growth equal to or greater than 7% and less than or equal to 20%;
• Estimated future EPS growth greater than 6% per year for the long run;
• Sales growth equal to or greater than 70% of the EPS growth and equal to or greater than 7% in absolute value;
• Return over PE ratio equal to or greater than twice the market (or industry) average;
• Positive cash flow;
• Quarterly EPS greater than the EPS of the same quarter of the previous year.

3.3 Warren Buffett (1930 -)

Warren Buffett is widely recognized as one of the most successful investor of all times. His investments outperformed the market in 20 out of 24 years, from 1980 to 2003. A disciple of Benjamin Graham, Buffett also follows the value investing philosophy and seeks companies with simple products, great public appeal, and a strong brand.

Reese and Forehand (2009) translated Buffett’s investment strategy into quantitative rules and suggested the guidelines below, which we used to build the WB portfolio. The software returned a portfolio of 73 assets. The high number of assets reflects the absence of a quantitative criterium to determine the strength of a brand. Buffett would not diversify his portfolio to this extent. The guidelines underlined by Reese and Forehand (2009) are:

• EPS equal to or greater than the previous year’s, for the last 10 years and no negative EPS;
• Long term debt less than or equal to twice the earnings;
• Return on equity (ROE) equal to or greater than 15% in the last 10 years’ average;
• Return on total capital (ROTC) equal to or greater than 12% in the last 10 years’ average;
• Positive cash flow;
• Use of retained earnings equal to or greater than 15%;
• Initial rate of return (EPS over price) equal to or greater than the rate of return of government bonds;
• Expected return by ROE method equal to or greater than 15%;
• Expected return by EPS method equal to or greater than 15%;
• Average expected return equal to or greater than 15%.

4The portfolio of Berkshire Hathaway featured 36 assets in March, 2010, according to CNBC (http://www.cnbc.com/id/22130601/)
3.4 Peter Lynch (1944 - )

Peter Lynch is a successful growth investor, with an annual average return of 29.2% from 1977 to 1990, while the market average was 15.8% in the same period. Lynch’s investment style focused on companies with well-known products and high growth prospect, even if their prices were not so low. Lynch divided assets into three categories: fast growth (whose earnings grow more than 20%), stalwarts (whose earnings grow between 10% and 19%) and slow growth assets. This classification played an important role in his investment strategy.

Reese and Forehand (2009) translated Lynch’s investment strategy into quantitative rules and suggested the guidelines below, which we used to build the PL portfolio. The software returned a portfolio of 89 assets. The high number of assets reflects the absence of a quantitative criterium to determine whether a product is well-known. Lynch would not diversify his portfolio to this extent\(^5\). The guidelines underlined by Reese and Forehand (2009) are:

- PEG (price to earnings growth) ratio greater than 0 and less than or equal to 0.5 (with tolerance until 1);
- Inventory-to-sales ratio variation negative or null;
- Debt to equity ratio less than 30% (with tolerance until 50%);
- For fast growers:
  - Sales greater than US$ 1 billion;
  - PE less than or equal to 40;
  - EPS equal to or greater than 20%, and less than or equal to 25%.
- For stalwarts:
  - Sales equal to or greater than US$ 1.9 billion;
  - Positive EPS.
- For slow growers:
  - Sales greater than US$ 1 billion;
  - Return greater than that of the S&P 500 and equal to or greater than 3%.

3.5 Kenneth Fisher (1950 - )

Kenneth Fisher is another successful growth investor, with an annual average return of 13% from 1995 to 2007, while the market average was 11.3% in the same period. Fisher’s

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\(^5\)The Magellan Fund of Fidelity Investments, administered by Lynch, with 80% of its allocation of funds in stocks, had stocks of only 10 companies in July 2010, according to USNews (http://money.usnews.com/funds/fidelity-magellan-fund/fmagx/holdings)
investment style focuses more on sales than on earnings, with the rationale that sales reflect a company’s popularity and hence the potential of overcoming low earnings in the long run.

Reese and Forehand (2009) translated Fisher’s investment strategy into quantitative rules and suggested the guidelines below, which we used to build the KF portfolio. Some of the criteria allow for a tolerance margin that distinguishes assets with great potential from merely tolerable assets. However, Fisher recommends investing in both. The software returned a portfolio of 57 assets. The guidelines underlined by Reese and Forehand (2009) are:

- Price-to-sales ratio (PS) less than or equal to 0.75 (tolerance until 1.5) for technological and non-cyclical companies;
- Price-to-sales ratio (PS) less than or equal to 0.4 (tolerance until 0.8) for cyclical companies;
- Debt-to-equity ratio less than or equal to a 40%;
- PR (price over investment in R&D) ratio less than 5 (tolerance until 10);
- EPS growth greater than 15%;
- Positive cash flow;
- Net profit margin equal to or greater than 5% in the average of 3 years.

4 Empirical Tests

We estimated the CAPM and the FF3F model for the 5 portfolios built as described in the previous section. We computed each portfolio price as the equally weighted average of the prices of the assets that constitute the portfolio.

We then used the average monthly price history for each portfolio, between January 2007 to January 2010\(^6\), in order to generate a table containing the portfolio’s return (monthly variation of the average price), HML return, SMB return, and \(R_m - R_f\) return. The latter three were obtained from Kenneth French’s online library. We estimated the betas for each portfolio using Ordinary Least Squares. The regressions were run on SAS.

The analysis could be affected by survivorship bias, since only stocks from active companies were selected. However, the goal of the present analysis is to study portfolios that would follow a set of rules today. Companies that went bankrupt certainly would not follow many of these rules or would not constitute a big share of each portfolio. Therefore, the conclusions here presented are related to the study of assets in a broad sense, which implicitly takes as one of the conditions the company’s own survivorship to be part of the portfolio.

\(^6\)A period before 2007 would generate significantly smaller portfolios, since many companies selected went public only after 2006.
Table 1: Results (standard errors in parenthesis)

<table>
<thead>
<tr>
<th>Coefficient ( \beta )</th>
<th>BG</th>
<th>JN</th>
<th>WB</th>
<th>PL</th>
<th>KF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPM</td>
<td>1.32 (0.17)</td>
<td>0.87 (0.09)</td>
<td>0.96 (0.07)</td>
<td>1.08 (0.07)</td>
<td>1.15 (0.06)</td>
</tr>
<tr>
<td>FF3F ( (R_m - R_f) )</td>
<td>1.25 (0.19)</td>
<td>0.76 (0.11)</td>
<td>1.04 (0.08)</td>
<td>1.09 (0.08)</td>
<td>1.17 (0.06)</td>
</tr>
<tr>
<td>FF3F (SMB)</td>
<td>1.12 (0.38)</td>
<td>-0.09 (0.22)</td>
<td>0.37 (0.16)</td>
<td>1.38 (0.17)</td>
<td>0.52 (0.12)</td>
</tr>
<tr>
<td>FF3F (HML)</td>
<td>-0.30 (0.22)</td>
<td>0.23 (0.12)</td>
<td>-0.30 (0.09)</td>
<td>-0.17 (0.09)</td>
<td>-0.24 (0.07)</td>
</tr>
</tbody>
</table>

Table 2: Goodness of fit \((R^2)\)

<table>
<thead>
<tr>
<th>( R^2 )</th>
<th>BG</th>
<th>JN</th>
<th>WB</th>
<th>PL</th>
<th>KF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPM</td>
<td>0.61</td>
<td>0.71</td>
<td>0.82</td>
<td>0.86</td>
<td>0.90</td>
</tr>
<tr>
<td>FF3F</td>
<td>0.69</td>
<td>0.74</td>
<td>0.87</td>
<td>0.88</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Table 3: Goodness of fit (adjusted \( R^2 \))

<table>
<thead>
<tr>
<th>Adjusted ( R^2 )</th>
<th>BG</th>
<th>JN</th>
<th>WB</th>
<th>PL</th>
<th>KF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPM</td>
<td>0.60</td>
<td>0.70</td>
<td>0.81</td>
<td>0.85</td>
<td>0.90</td>
</tr>
<tr>
<td>FF3F</td>
<td>0.67</td>
<td>0.71</td>
<td>0.85</td>
<td>0.87</td>
<td>0.93</td>
</tr>
</tbody>
</table>
As expected, the FF3F model performed better than the CAPM, even when we considered the adjusted $R^2$. Nevertheless, the explanatory power of the CAPM was relatively high for the five portfolios. The KF portfolio is the one best explained by both models, with 93% of its variation explained by the three variables of the FF3F model. On the other hand, the BG portfolio had the smallest $R^2$. This result was expected, because the BG portfolio featured only 13 assets.

The most significant coefficient in the FF3F model is the market return $\beta$, also present in the CAPM. Hence, even though the 3-factor model performed better than the CAPM, a considerable part of this performance comes from the same variable found in the simpler model. The BG, JN and WB portfolios are based on the value investing philosophy. The PL and KF portfolios are based on the growth investing philosophy. The two models have performed significantly worse for the value investing portfolios, with an average adjusted $R^2$ of 0.70 for the CAPM and 0.74 for the FF3F model. The growth investing portfolios had an average adjusted $R^2$ of 0.87 for the CAPM and 0.90 for the FF3F model.

The signs of the SMB and HML coefficients indicate the group of assets to which the portfolios belong. When the sign of the SMB coefficient is positive, the return on the portfolio varies in the same direction as the return of a portfolio based on small companies, thus suggesting that the portfolio features mainly assets from small companies. The BG portfolio, for example, has a high SMB coefficient, which suggests that it includes assets from small companies. This observation apparently contradicts the notion of value investing, and might be the result of the period from which the data was obtained, which includes the 2008 economic crisis.

Therefore, our findings suggest that the growth investing philosophy is more strongly related to the variables $(R_m - R_f), \text{SMB, and HML}$ than the value investing philosophy. The ability of both models to explain growth investing is the result of the composition of the market return. When we consider the composition of the S&P 500 Pure Growth and Pure Value indexes, it is clear that they contain more growth companies than value companies. These indexes summarize the return on portfolios built solely on growth and value characteristics. On August 25, 2010, the Pure Growth index had 117 companies with a total adjusted market cap of US$ 1,439.38 billion, while the Pure Value index had 100 companies with a total adjusted market cap of US$ 792.76 billion. Hence, the greater presence of growth companies on the market might explain the better performance of both models when applied to the portfolios based on the growth investment philosophy.

The portfolio performances were tested applying commonly used measures of return anomalies. Such measures describe how much the predictions differ from the observations. One of these measures is the Alpha of Jensen ($\alpha$), which evaluates the difference between observed and predicted returns. Another measure is the Treynor Ratio ($T$), which calculates the ratio of observed excess return to the beta computed from the CAPM. The values of these measures were computed using the real average return of each portfolio and the CAPM-

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7 Indeed, the BG portfolio contains only 5 companies whose each market cap surpasses US$ 1 billion in August, 2010.
predicted return. The third measure computed is the Sharpe Ratio ($S$) – the ratio of expected return to volatility. The formulas for these measures are:

$$\alpha = ER_i - [R_f + \beta_i(ER_m - R_f)]$$

$$T = \frac{ER_i - R_f}{\beta_i}$$

$$S = \frac{E[R_i - R_f]}{E[(R_i - R_f)^2]^{\frac{1}{2}}}$$

Despite their popularity, these measures simplify the notion of risk, giving the same weight to positive and negative return variations. However, investors dislike negative variations and like positive variations. Thus, we also computed a slightly more sophisticated measure. The Sortino-Satchell Ratio ($SS$) is an improvement of the Sharpe Ratio that penalizes returns below a certain threshold (the risk-free rate). Only returns below this limit are considered. When the Sortino-Satchell Ratio parameter is $q = 2$, it is called Sortino Ratio. We also compute this measure with $q = 3$ for the five portfolios. The formula for this measure is:

$$SS = \frac{E[R_i - R_f]}{E[(R_i - R_f)^q]^{\frac{1}{q}}}$$

Table 4: Average portfolio return between 01/2007 and 01/2010

<table>
<thead>
<tr>
<th></th>
<th>BG</th>
<th>JN</th>
<th>WB</th>
<th>PL</th>
<th>KF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average return (%)</td>
<td>-0.271</td>
<td>0.317</td>
<td>0.917</td>
<td>0.263</td>
<td>0.476</td>
</tr>
</tbody>
</table>

Table 5: CAPM expected return between 01/2007 and 01/2010

<table>
<thead>
<tr>
<th></th>
<th>BG</th>
<th>JN</th>
<th>WB</th>
<th>PL</th>
<th>KF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected return (%)</td>
<td>-0.158</td>
<td>0.065</td>
<td>0.020</td>
<td>-0.039</td>
<td>-0.074</td>
</tr>
</tbody>
</table>

The WB portfolio had the highest average return, around 0.9% for the period considered. However, in this period the market average return was -0.5% and the CAPM expected return for the WB portfolio was only 0.02%. Hence, this portfolio displayed the highest values for almost all measures computed. However, when we consider the Sortino and the Sortino-Satchell measures, the BG portfolio exhibits the highest values (in absolute value). The CAPM beta for the BG portfolio is 1.32, which indicates that the BG portfolio is relatively risky. One would expect that its return is closely related to the market return, for the period analysed. Indeed, the market had a negative return for the period considered and this
Table 6: Measures of return anomaly

<table>
<thead>
<tr>
<th>Measure</th>
<th>BG</th>
<th>JN</th>
<th>WB</th>
<th>PL</th>
<th>KF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jensen’s Alpha</td>
<td>-0.112</td>
<td>0.252</td>
<td>0.896</td>
<td>0.302</td>
<td>0.550</td>
</tr>
<tr>
<td>Treynor Ratio</td>
<td>-0.584</td>
<td>-0.209</td>
<td>0.434</td>
<td>-0.218</td>
<td>-0.020</td>
</tr>
<tr>
<td>Sharpe</td>
<td>-0.080</td>
<td>-0.031</td>
<td>0.068</td>
<td>-0.035</td>
<td>-0.003</td>
</tr>
<tr>
<td>Sortino</td>
<td>-0.069</td>
<td>-0.025</td>
<td>0.058</td>
<td>-0.029</td>
<td>-0.003</td>
</tr>
<tr>
<td>Sortino-Satchell (q = 3)</td>
<td>-0.059</td>
<td>-0.022</td>
<td>0.050</td>
<td>-0.025</td>
<td>-0.002</td>
</tr>
</tbody>
</table>

The ranking of the portfolios according to the five measures computed is almost the same for all of them. There is a reordering only relative to the JN and PL portfolios. The latter has a higher Jensen’s Alpha while the former has a higher Treynor Ratio. This finding can be explained by the fact that the PL portfolio’s beta is reasonably higher than the JN portfolio’s beta. Considering the other measures, the KF portfolio is the one with lowest anomalous returns, in absolute values. The WB and BG portfolios have the highest deviation from the models’ predicted return.

Considering all measures, the WB portfolio displayed the best performance for the period analyzed. On the other hand, the BG portfolio displayed the worst performance for the period analyzed. Table 7 below ranks the portfolios according to each measure.

Table 7: Rank of Portfolios according to each Measure

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Jensen’s Alpha</th>
<th>Treynor Ratio</th>
<th>Sharpe</th>
<th>Sortino</th>
<th>Sortino-Satchell</th>
</tr>
</thead>
<tbody>
<tr>
<td>WB</td>
<td>1st</td>
<td>1st</td>
<td>1st</td>
<td>1st</td>
<td>1st</td>
</tr>
<tr>
<td>KF</td>
<td>2nd</td>
<td>2nd</td>
<td>2nd</td>
<td>2nd</td>
<td>2nd</td>
</tr>
<tr>
<td>JN</td>
<td>4th</td>
<td>3rd</td>
<td>3rd</td>
<td>3rd</td>
<td>3rd</td>
</tr>
<tr>
<td>PL</td>
<td>3rd</td>
<td>4th</td>
<td>4th</td>
<td>4th</td>
<td>4th</td>
</tr>
<tr>
<td>BG</td>
<td>5th</td>
<td>5th</td>
<td>5th</td>
<td>5th</td>
<td>5th</td>
</tr>
</tbody>
</table>
Assuming that the CAPM and the FF3F model are good models for the market, the WB portfolio has the best performance, controlling for its risk. It displays returns higher than the ones predicted by these two models. The KF portfolio is the second best investment strategy.

For the sake of comparison, we also assembled a benchmark portfolio from the same universe of stocks, using a simple Mean-Variance algorithm, through a Bloomberg Professional tool. In the aforementioned period, the MV portfolio returned on average -0.16%, with a standard deviation of 5.2%. Jensen’s Alpha for the MV portfolio was 0.31%, while Treynor’s Ratio was -0.187%. The Sharpe Ratio was -0.03%, the Sortino Ratio was 0.328%, and the Sortino-Satchell Ratio \((q = 3)\) was 0.247%. In this sense, the naïve MV portfolio had an average performance when compared to the investor-based portfolios. This result can either be seen compatible with the efficient market hypothesis or as a validation of the WB and KF portfolios’ superior performance.

5 Conclusion

We tested two of the most widely-recognized asset pricing models, using portfolios built in a realistic fashion. The construction of the portfolios was based on investment strategies used by investors. This is an approach not common in the asset pricing literature.

The tests of the CAPM and the FF3F model using these more realistic portfolios aim to direct the literature towards a more practical perspective. The two asset pricing models tested had relatively good performance in explaining the expected returns of these portfolios. The great explanatory power, especially of the FF3F model, suggests that these models have possibly more explanatory power than previously imagined. They might also indicate sizable investment opportunities in mispricing situations.

Among the tested portfolios, those based on the growth investing philosophy were significantly better explained by the two asset pricing models considered. This is an indication that deviations between observed and predicted returns might entail profit opportunities from possible mean reversions, especially on the better adjusted one, the KF portfolio. We also found that the portfolio built on guidelines based on Warren Buffett’s investment strategy had the highest level of anomalous returns, which might indicate another good investment opportunity.

This line of research can be further pursued. Other asset pricing models can be tested on portfolios built like the ones used here. It would also be interesting to test the models on portfolios based on guidelines from other investors besides the ones we used. Furthermore, other measures can be used to test the adjustment of the models and the presence of anomalous returns.

Considerable opportunities for improvement in the literature of asset pricing models still remain. It is possible that models that did not perform well in the past could display a better explanatory power if the portfolios tested were more closely related to the reality of asset management and portfolio engineering.
References


