

Assignment 1 Memo

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1 Executive Summary

This document outlines a ~ 30 year backtest of a trading strategy that separates firms with Research and Development spending in the previous year from those without. The backtest was performed on firms inside Standard & Poor's Compustat data base and accessed through Wharton Research Data Services (WRDS). The success of these strategies were evaluated based on the resulting alpha values generated in a regression against market returns, as done in the Capital Assets Pricing Model and Fama French 3 Factor Model. This was done with both equally weighted and value weighted portfolios for Non-RnD as well as positive RnD firms (separated by quintile). The resulting alphas were then paired to form three zero-cost portfolios which had their own alpha values when regressed against the market. These alphas were found to be statistically significant, implying one could create a trading strategy that generates above market returns from this analysis.

2 Objective

According to Arbitrage Pricing Theory, we should expect that a sufficiently diversified portfolio (such as the RnD and No RnD portfolios) would have zero alpha as it would induce an arbitrage opportunity for investors. In practice, positive, statistically significant alphas can be found and exploited. The goal of this research is to form RnD quintile portfolios over different time periods, test for non-zero alphas, and formulate long-short, zero-cost portfolios that attempt to extract risk free returns from the market larger than the risk-free rate.

3 Methodology

Filters

Annual fundamentals data was collected from the WRDS Compustat data base between 1981-07-01 and 2022-12 and filtered according to the following constraints:

- Currency is USD
- FIC is USA
- Exclude SIC 6000-6999 (financials)
- Exclude SIC 2834 (pharmaceuticals)
- Stock exchange is 11-19

Sorting into Quintiles

The following sorting variable was created from the XRD (research expense) and ME (market cap) variables:

$$\left(\frac{RDC}{ME}\right)_t = \frac{XRD_t}{ME_{t_0}} + 0.8 \cdot \frac{XRD_{t-1}}{ME_{t_0}} + 0.6 \cdot \frac{XRD_{t-2}}{ME_{t_0}} + 0.4 \cdot \frac{XRD_{t-3}}{ME_{t_0}} + 0.2 \cdot \frac{XRD_{t-4}}{ME_{t_0}}$$

This was used to sort firm into quintiles annually (yearly rebalancing), with Non-RnD firms (RDC/ME = 0) first being separated.

Equal, Valued Weighted, and Small Cap Portfolios

The returns of an equal weight portfolio for each trading strategy were constructed using a simple mean of the returns in each series. Taking the mean effectively weights each return equally, resulting in a final portfolio return representing an equally weighting of all composite firms. The returns of a value weighted portfolio use the formula

$$\sum_i r_{it} w_{it}$$

Where w_t is the share of the total portfolio market cap of firm i at time t and r the return.

The returns of a small cap portfolio were created by removing the 1000 largest market cap firms in each time period and then weighting equally.

4 Findings

The returns of the equal, value weighted, and small cap portfolios were used to find the α of regression values against the market returns as done in the CAPM and Fama French 3 Factor models as well as the Sharpe Ratio. The following results were found for the time period of 1981-07-01 to 2012-12-31.

For the equal weight long/short portfolio, the CAPM and FF3 alphas and Sharpe Ratio were:

Long/Short Portfolio Summary			
	Alpha	FF3 Alpha	Sharpe
	1.37%	1.35%	1.061
T-Stat	5.569	5.867	

For the value weight long/short portfolio, the CAPM and FF3 alphas and Sharpe Ratio were:

Long/Short Portfolio Summary			
	Alpha	FF3 Alpha	Sharpe
	0.25%	-0.09%	0.280
T-Stat	0.928	-0.369	

For the equal weight small cap long/short portfolio, the CAPM and FF3 alphas and Sharpe Ratio were:

Long/Short Portfolio Summary			
	Alpha	FF3 Alpha	Shapre
	1.52%	1.56%	1.234
T-Stat	6.515	7.098	

5 Portfolio Formulation and Evaluation

The long/short portfolios were created by taking High RnD returns (Quintile 5) and subtracting Low RnD returns (Quintile 1). The equal weight and small cap portfolio showed a “RnD effect”. That is, they had statistically significant alphas against the market and Fama French factors. The value weight portfolio showed no RnD effect. Since equal weighting tends to emphasize the relatively numerous small firms over the few big firms, it can be reasoned that the market is less efficient in pricing the RnD implications of smaller firms. As such, this may form the basis of a trading strategy that invests in small firms with high relative RnD expense.