To: Sury and Titman Investments, LLC

From: Jordan Ehlinger (je28596)

Subject: R&D Expenditure Strategy Exploration

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This memo explores a new potential alpha-generating strategy based on examining companies that have reported positive R&D expenditure the previous year. A series of portfolios were created to test the hypothesis that companies with positive R&D expenditure generate higher returns than companies with no or negative reported R&D expenditure. The portfolios were broken down by two attributes: weighting and R&D expenditure.

For determining the weights within each portfolio, first an equal-weighted approach was used and then a value-weighted portfolio was also explored, where each security was weighted by its market cap relative to the total market cap of all the securities in the portfolio. For this report, market cap was calculated using quarterly common shares outstanding and the monthly price close from the CRSP/Compustat Merged cube within the WRDS database. The quarterly common shares outstanding values were converted to monthly values through interpolation before they were multiplied by the equivalent monthly close price to get the market cap for that time-period. After the market cap was calculated, these values were shifted forward one month because these values are reported at the end of the month. For the R&D split, each year the portfolios were restructured with one portfolio consisting of securities where the company had a positive expenditure in R&D the previous year and another portfolio for the securities where the company had no R&D expenditure. Values for R&D expenditure were pulled from the CRSP/Compustat Merged cube as well and to avoid look-ahead bias they were shifted forward in time by three months to create a more accurate reflection of when the market would acquire this information. The performance of each portfolio is tracked from January 1990 until December 2022 with the securities included in each portfolio being restructured each year and the weighting of each portfolio being recalculated each month. The performance of each security is measured by its total monthly return. The risk-free rate is subtracted for the matching time-period from the portfolio and index returns. Performance of the portfolio is measured using the alpha calculated from running a linear regression of the portfolio's monthly excess returns as the dependent variable and the monthly excess returns of the CRSP value-weighted index as the independent variable. The statistical significance of each portfolio's alpha is measured using its t-statistic, standard error, and p-value. A portfolio's alpha represents the average return of the portfolio that is not explained by the market returns. Therefore, a statistically significant, positive alpha means the portfolio has an average return above zero when the market return is zero. In addition to the four excess returns portfolios, a long-short portfolio was also created for each weighting method, where the no R&D monthly returns were subtracted (shorted) from the R&D monthly returns. The long-short portfolios were also regressed against the excess returns of the CRSP value-weighted index.

After pulling the data from the CRSP database, extensive cleaning was done to get the necessary data into useable pandas data frames. Next, two dictionaries were created to capture which companies belong in each portfolio each year. Using these dictionaries as a filter, two new data frames were created to hold the monthly returns for the R&D expenditure and the no R&D expenditure portfolios. Afterwards, two copies of each portfolio were created and the different methods of weighting the individual securities were applied to these copies. With the monthly returns of the four base portfolios, the excess returns and the long-short portfolios are calculated. Finally, each portfolio's excess returns are run through a linear regression model with the index's excess returns. The results of these models are displayed in Exhibit 1 at the bottom of the memo.

The method chosen to weight the portfolio had a strong impact on the alpha generation of the model. Beginning by looking at the non-R&D portfolios, the alpha generated from the equal-weighted portfolio was 0.0039 with a t-stat of 2.225, while the value-weighted portfolio had an alpha of 0.0005 with a t-stat of 0.809. The alpha generated from the equal-weighted portfolio is an order of magnitude larger and statistically significant, which demonstrates the clear increase in performance achieved from equal-weighting the securities. This effect is equally present for the R&D portfolios, but not for the long-short portfolios where portfolio construction has a greater effect on the results. The difference in weighting also leads to different market betas. The equal-weighted non-R&D portfolio had a beta of 1.1249, while the value-weighted non-R&D portfolio's beta was 0.8697.

The difference in alpha generation based upon R&D expenditure was less notable. Looking at the equal-weighted portfolios, the alpha for non-R&D was slightly larger and more statistically significant than the R&D alpha, but for the value-weighted portfolios we saw the opposite effect. It is important to note that neither of the alphas for the value-weighted portfolios are statistically significant.

The long-short portfolios performed worse than the four excess return portfolios, but this is expected. Long-short portfolios are zero-cost and hedged against risk, which make them much more attractive, but less likely to generate any significant alpha. The decrease in risk can be seen by their market betas, which sit around 0.22. For the alpha performance, both sit in the ten-thousandths place with t-stats below 0.5 so they are not statistically significant.

Further experimentation is recommended. Generally, equal-weighted is not the best approach because it requires frequent rebalancing, which leads to higher transaction costs. It can also introduce bias by forcing the portfolio to sell its winners and buy its losers, but the overperformance of the equal-weighted portfolio does provide a valuable insight. Equal-weighted portfolios provide more exposure to smaller companies, which gives evidence to the hypothesis that the R&D strategy is more effective with small cap securities. To test this hypothesis, new portfolios should be created that are value-weighted, but solely among the smaller firms.

Exhibits

Exhibit 1: Performance of the different portfolios

	EW Non-R&D	VW Non-R&D	EW R&D	VW R&D	EW Long Short	VW Long Short
ALPHA	0.0039	0.0005	0.0032	0.0007	-0.0006	0.0002
STD ERR	0.002	0.001	0.002	0.001	0.002	0.001
T-STAT	2.225	0.809	1.488	0.965	-0.374	0.193
BETA	1.1249	0.8697	1.3386	1.1005	0.2137	0.2309