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Selecting stocks and building portfolios: a sorting exercise

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Abstract

Purpose – The purpose of paper is to provide students with a sorting methodology to select securities and build portfolios.

Design/methodology/approach – This paper uses various accounting variables for all firms in the S&P 500, sorted by sector. The fundamental metrics are converted into standardized Z-scores and then combined into a single score used to rank individual firms within each industry. Equity portfolios are then constructed using the aggregate Z-scores.

Findings – In the authors' experience with student-managed investment funds (SMIFs), students at the start of the course consistently ask how to begin selecting securities or seek to learn a new model for selecting securities. Discussions on stock selection are helpful to engage students in this area, but an attempt is made to further this by providing a comprehensive stock-selection exercise to help students better understand how to appropriately pick stocks and create a portfolio.

Practical implications – In this exercise, students are reminded of the limitations surrounding the stock-screening process and are provided with an alternative, more robust method for selecting securities that is commonly utilized by investment professionals. While the exercise described in this paper is done in reference to SMIFs, it is equally applicable to standard investment courses.

Originality/value – This paper provides an exercise which provides students a way to dive deeper into stock selection through stock sorting. Stock selection is typically a hot topic for most students in finance courses. Stock screens may permit a search on multiple variables simultaneously but typically do not allow for applying specific weights to each metric. A sorting method, avoids these issues by permitting the user to create custom variables, affords the opportunity to view all of the variables used in the screening process simultaneously, and includes the option to apply specific weights to each variable.

Keywords Sorting, Z-scores, Students, Investment funds, Investments

Paper type Case study

1. Introduction

A common question arises in many investment courses or especially in student-managed investment fund course. That question is how do you figure out what stocks to buy? The obvious answer might be to buy a diversified group of stocks spanning numerous industries. Perhaps, a step further might be to choose among different sized firms or maybe come up with a value or growth strategy. The problem is with the entire stock universe, what is the proper method in selecting the right stocks to form a good portfolio. In this exercise, we address this issue and create an exercise in which students can form a portfolio based on a stock sorting Z-score method. This exercise provides an application of portfolio concepts, which can be used in any investment course or a great practice tool for students managing money in a student-managed investment fund.

Stocks screens are one of the most common methods for introducing a means of selecting stocks and building portfolios. A stock screen is a systemic process in which the universe of stocks is sequentially reduced to a set of favorable securities based on the

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investor's preferences. Stock screens typically are applied first based on the most important criterion, then the second most important, and so on until the entire set of criterion identified by the investor to be essential is exhausted. For example, if you believe that small cap, growth stocks will have the highest excess returns then you will first rank stocks based on market capitalization and select those firms below the median or in the lowest quartile. The next screen for growth would involve ranking selected small-cap securities from highest to lowest by price-to-book (P/B) and selecting the stocks with P/B ratios above the median or in the top quartile and so on.

While very popular, there are limitations to the simple method of selecting securities using stock screens. Owing to the sequential nature of the screening process, there is a chance of eliminating an otherwise favorable stock simply because it failed any one of the initial screens. There are some free screening tools, such as those found on Yahoo Finance and MSN Money, that do allow the user to consider multiple factors at the same time. These tools, however, do not provide a quantitative basis to rank the overall strength of each firm based on the total search criterion. The option to create or include additional variables is often quite limited or nonexistent.

Stock sorting may be a preferred method since sorting allows a numerical value to be assigned to each financial factor and permits the computation of an overall score which may be used to rank the firms and make numerical comparisons. One issue that arises when creating a numerical measure for comparing all of the variables simultaneously is that the values are of different scale. For example, how would one simultaneously compare a P/B ratio of two with a market capitalization of 15 billion? The Z-score standardization method is commonly used in practice as it scales each variable by comparing the value to its industry's mean value and then dividing the difference by the industry standard deviation. The standardization process enables the user to weight and combine different fundamental variables into an overall ranking score. The Z-score may also be used to determine the percentage of firm's within the same industry with a lower value for any given accounting variable.

2. Exercise method

The initial step in the sorting process is to sort the firms by industry and convert the various accounting variables into standardized Z-scores. The standardized Z-scores are formulated as follows:

- Compute the industry mean and standard deviation for each variable.
- The Z-score for each variable is calculated by subtracting each firm's variable from that variables industry average and then dividing by the corresponding industry standard deviation.

The Z-score is calculated with the following equation:

$$Z_i = \frac{(X_i - \mu_j)}{\sigma_j} \tag{1}$$

where:

X_i is the factor for firm i.

μ_j is the factor mean for industry j.

σ_j is the standard deviation of the factor for industry j.

For example, if firm XYZ has a P/B of 4.94 and the industry average and the standard deviation for P/B is 2.0 and 1.5, respectively; the resulting Z-score for XYZ's P/B is 1.96. So, what does a Z-score of 1.96 imply? A Z-score of 1.96 indicates XYZ's P/B is approximately two standard deviations greater than the industry mean. In other words, there is only a 2.5 percent probability of finding another firm in the same industry with a P/B higher than that of XYZ. To obtain specific probabilities for any Z-score, simply locate the corresponding value in the standard normal distribution table which provides the percentage of firms likely to have a multiple, ratio, or other factor value lower than the firm in question. As a point of reference, a few select Z-scores and the corresponding probabilities (the percentage of firms with lower accounting values) are listed in Table I.

Table II lists a set of accounting variables for ten firms in the transportation sector of the S&P 500 while Table III provides the respective individual Z-scores. The data for this exercise were collected from Reuters and represents the financial values from the year 2006. The analysis year chosen preceded the financial crisis, in order to avoid any extraordinary fundamentals that followed, but may easily be applied to the any year if desired.

The next step in the process is to aggregate the various factor Z-scores into the firm's overall aggregate Z-score as is shown in Table IV. It is important when combining the factor Z-scores to determine the appropriate sign to be applied to each variable if ultimately a higher aggregate Z-score is preferred. Assigning a positive sign to factors where higher values are favorable and a negative sign (reversing the sign) to variables in which lower values are preferable leads to a higher aggregate Z-score for firms representing the best investment opportunity. For example, followers of a

Table I.
Z-scores and probabilities

Z-score	Firms with lower values (approx.) (%)
−1.00	15.87
−0.50	30.85
0.00	50.00
0.50	69.15
1.00	84.13

Table II.
Financial variables for firms in the transportation sector

Ticker	TTM	P/E	GMgn	ROE%	ROA%	DbtLTE	Sales(%)Chg
BNI	4.22	14.29	37.83	17.81	5.85	0.65	18.03
CSX	35.63	16.67	60.36	11.74	3.94	0.57	12.05
FDX	5.06	16.67	28.02	17.26	8.63	0.16	10.10
LUV	−6.76	25.00	31.31	7.89	3.66	0.19	21.32
NSC	12.18	14.29	38.40	15.77	5.67	0.64	13.70
UNP	14.30	16.67	34.56	10.07	3.96	0.45	15.66
UPS	−0.23	20.00	30.14	24.40	11.57	0.18	15.83
Mean	9.20	17.65	37.23	14.99	6.18	0.41	15.24
SD	13.66	3.77	10.91	5.59	2.94	0.22	3.75

Note: Sorting factors – December 2006

value investment strategy prefer stocks with a price-to-earnings (P/E) ratio below the industry average or firms with a negative P/E Z-score. The farther the P/E is below the industry average; the more negative the Z-score. Thus, applying a negative sign to a negative Z-score will result in a high positive Z-score for purposes of aggregation and achieve the required valued strategy.

Suppose the goal is to find firms with relatively low debt but high values for all of the remaining variables, then combining the factor Z-scores would require assigning a negative sign in front of the Z-score for debt-to-equity (DbtLTE) and a positive sign before the remaining Z-scores:

$$\text{Aggregate}\,Z-\text{score}=\frac{Z_{\text{TTM}}+Z_{\text{P/E}}+Z_{\text{GMgn}}+Z_{\text{ROE\%}}+Z_{\text{ROA\%}}-Z_{DbtLTE}+Z_{\text{Sales\%Chg}}}{\text{n}}$$

By dividing the combined Z-scores by the number of total factors it would result in an equal weighting applied to each variable. Referring to Table IV, the aggregate Z-score for CSX corporation (CSX) would be 0.12. Calculated as the following:

$$\text{CSX}\;\;Z-\text{score}=\frac{(1.94+(-0.26)+2.12+(-0.58)+(-0.76)-0.73+(-0.85))}{7}=0.12$$

The groups of students may, however, prefer to assign weights based upon the perceived importance of each financial variable instead of taking a simple average

Ticker	TTM	P/E	GMgn	ROE%	ROA%	DbtLTE	Sales(%)Chg
BNI	−0.36	−0.89	0.05	0.50	−0.11	1.09	0.74
CSX	1.94	−0.26	2.12	−0.58	−0.76	0.73	−0.85
FDX	−0.30	−0.26	−0.84	0.41	0.83	−1.10	−1.37
LUV	−1.17	1.95	−0.54	−1.27	−0.86	−0.96	1.62
NSC	0.22	−0.89	0.11	0.14	−0.17	1.05	−0.41
UNP	0.37	−0.26	−0.24	−0.88	−0.76	0.20	0.11
UPS	−0.69	0.62	−0.65	1.68	1.83	−1.01	0.16

Note: Z-scores – December 2006

Table III.
Individual Z-scores for firms in the transportation sector

Ticker	TTM	P/E	GMgn	ROE(%	ROA%	DbtLTE[a]	Sales(%)Chg	Aggregate Z-score
BNI	−0.36	−0.89	0.05	0.50	−0.11	−1.09	0.74	−0.17
CSX	1.94	−0.26	2.12	−0.58	−0.76	−0.73	−0.85	0.12
FDX	−0.30	−0.26	−0.84	0.41	0.83	1.10	−1.37	−0.06
LUV	−1.17	1.95	−0.54	−1.27	−0.86	0.96	1.62	0.10
NSC	0.22	−0.89	0.11	0.14	−0.17	−1.05	−0.41	−0.29
UNP	0.37	−0.26	−0.24	−0.88	−0.76	−0.20	0.11	−0.27
UPS	−0.69	0.62	−0.65	1.68	1.83	1.01	0.16	0.57

Notes: Aggregate Z-scores assumes equal weighting for each metric; [a]assumes all variables except DbtLTE (D/E) are preferred to have above average values; the sign is reversed for the D/E column in order to aggregate the variables such that the higher aggregate Z-score is preferred

Table IV.
Aggregate Z-scores for firms in the transportation sector

of all Z-scores. If profitability measures are considered more important in forecasting future stock price appreciation than a momentum metric, a larger weight is applied to the profitability Z-score. The application of signs and weights may be done in Excel in such a way to allow changes to signs or weights to automatically adjust the Z-scores. This way the exercise can allow for many different portfolio strategies.

Once the desired number of securities is identified, for example the 20 firms with the highest Z-scores, step three of the exercise is to allocate funds to the individual stocks and construct the portfolio. A simple method is to form an equally weighted portfolio by investing the same dollar amount in each security or determine weightings by market capitalization. Another alternative is to utilize a mean-variance optimization program such as solver in Excel to determine the optimal weights for each security. A long/short 120/20 or 130/30 hedge fund type of portfolio may also be formed by short selling those firms with the lowest Z-scores and using the funds to go long the firms with the highest Z-scores. Another alternative is to apply a sector rotation strategy, where certain sectors are allocated additional (fewer) funds in order to overweight (underweight) relative to the current sector weightings of the S&P 500.

The final step is the calculation of returns for the created portfolios. To do so, the portfolio created in this exercise, which was based on 2006 financial data, and establish if its return the following year exceeded that of the S&P 500. The return on the S&P 500 in 2007 was 3.53 percent. To compute the newly created portfolio's 2007 return, simply multiply the weights designated for each security by the respective return provided in the Excel spreadsheet for this exercise. The students' created portfolio returns can then be compared against others in the class and versus the S&P 500. To increase student interest in the created portfolio, better performance can be rewarded for each student or group of students. This way, each student or group will compete against each and the market. As an additional wrinkle, the performance can be calculated for the first six months of 2007 and then reported to the class. Then each group can rebalance their portfolio according to their desired return goal. This goal may or may not be impacted by the first six months of 2007 performance. This gives them the opportunity to continue a strategy or perhaps change a strategy that is not working. This added wrinkle in the exercise can bring up a good entry point to discuss mutual/hedge funds behaviors, and how they may respond if they are ahead or behind other funds and even more importantly the market after the first six months of the year. Student groups that are ahead of others and the market may choose to be more conservative while other weaker performers may become more aggressive.

3. Exercise questions for students to answer

1. Stock screen

- Create a stock screen or use a pre-existing screen to construct a portfolio. Present your final portfolio in a table and include the company names, ticker symbols, market capitalizations, and current stock price.
- Discuss which financial variables you used for your screen and the rationale for including each variable. Include a discussion regarding the order in which each factor was applied.
- List and describe potential shortcomings for the screen you used and/or for stock screens in general.

2. Sorting method

- Recreate Tables III and IV for the transportation sector and verify that the numbers match those in the case.
- Create Tables III and IV for the remaining sectors.
- Based upon the aggregate Z-scores in Table IV for all sectors, create a portfolio. Describe the final portfolio construction in terms of the number of securities selected and the weight applied to each security. (Feel free to also change the signs for combining Z-scores and/or changing the weights applied to each Z-score – in Table IV the Z-scores were equally weighted.) Justify the signs and weights used.
- Compare the performance of your portfolio versus the S&P 500 for 2007. Did your portfolio, which was formed based on Z-score sorting, outperform the S&P 500 for the year?
- List and describe how the sorting method provided more flexibility than the stock screen method.

4. Literature review

To justify a positive or negative weight coefficient for each of our seven variables used, we have two options. The first option is to intuitively look at the variable or factor and decide whether positive or negative is the correct sign. For some variables, this is easy and consistent across investment styles, such as earnings growth (20 percent is more obviously more favorable than 3 percent). The other option is to examine historical data, and regress our variables against stock returns over time, and discover if this variable is positively or negatively correlated with returns (a type of factor loading approach). Many studies have been done using the cross-sectional returns and analyze the seven variables selected in this exercise. We cite a few of the many papers in this section to help motivate the potential sign of each variable. Students can use this literature review, their own intuitive trading strategy, and their own research to motivate the direction of signs in the exercise as well as the weights of stocks selected.

The first variable we will discuss is P/E ratios. Nicholson (1960) studied the returns on 100 stocks over varying time spans from 1939 to 1959 and found that the 20 lowest P/E stocks showed more appreciation than the 20 highest ones. These results were persistent in more than 80 percent of the number of time periods studied. McWilliams (1996) did a similar study on 390 stocks from 1953 to 1964. He found similar results, with low P/E stocks producing higher returns than high P/E stocks. McWilliams also computed the standard deviations of returns for each group and found that the variability (risk) was the greatest in the low P/E stock category. He recommended selecting stocks in the third or fourth decile because their returns were still high but with less risk than the lower deciles. Basu (1977) found P/E ratios contributed to the cross-section explanatory power explaining returns. He also controlled for market size and market beta in this study.

The next variable to examine is P/B ratio. P/B examines how much a stock is valued by the market as compared to its book value. This brings up the value versus growth argument. Fama and French (1992) found that book-to-market (B/P) value was a better explanatory variable in predicting return than P/E ratio was. Haugen and Baker (1996) examined several factors to measure if stocks returns were impacted by certain variables.

He discovered that B/P ratio is not only positively correlated to abnormal stock returns but he took it one step further. For each number of standard deviations from the mean, B/P ratios produced a 0.35 percent excess return per month. These studies seem to favor the value approach to investing.

Interest coverage ratios demonstrate how well a firm can pay its debt as measured by its interest payments. This variable looks at leverage versus financial strength. Haugen and Baker (1996) discovered that the lowest decile of expected return stocks had an average interest coverage ratio of 1.76 times, while the top decile of expected return stocks had average interest coverage ratios of 6.63 times. Anantharaman (2008) studied betas and several accounting indicators of risk, including interest coverage ratios, to see if they indicated excess returns for incurring risk. His results were inconclusive to negative about interest coverage ratios ability to predict excess returns. His study did suffer from several statistical faults, namely survival bias and small-sample bias.

The next variable to discuss is debt-to-equity ratio. This variable looks to see if it is better for a firm to be financed through debt or equity. Modigliani and Miller (1958) argued increasing debt was good for the company and good for the shareholders to a point. For tax purposes, an increase in debt increased provided more capital at lower costs since the interest paid is deductible. Although increasing debt leads to financial distress as debt payments must be made or the firm goes into bankruptcy. At some inflection adding more debt forces additional debt to become a negative as bankruptcy cost are too high. O'Connor (1972) agreed with M&M for the most part. He also believed that there was added pressure put on the company, and these externalities were bad for the shareholder. During stock market expansions, highly leveraged companies did outperform, but during stock retractions though, highly leveraged companies suffered the largest losses. His evidence indicated slightly inferior risk-adjusted returns for highly leveraged companies showing the potential benefits of additional debt. Many studies are inconclusive on whether additional debt is favorable or unfavorable in terms of stock returns.

Return on equity (ROE) provides insight to how well firm's management performed the previous year. Haugen and Baker (1996) examined the ROE ratio in two ways. First, he examined the level of ROE on average for ten deciles of stocks. The lowest group had an average ROE of less than zero, which is not surprising as companies not earning a return had poor stock performance. The trend across all ten deciles is positive all the way to the tenth decile which averaged 15.39 percent. He also examined the trend on ROE which can be thought of as the change or growth in the return percentage based on a five-year trailing average. The best-performing firms had relatively consistent ROE over the time period, while the worst performing firms had a -1.18 percent change.

The next factor to be examined is gross profit. The idea is firms with higher gross profit margins will perform better than firms with lower profit margins. Daynes *et al.* (2008) worked on a paper similar to the study by Haugen and Baker (1996) examining how various factors impact future stock returns. Their study examines stocks in the UK market in two sub-periods based on 24 different factors. In the second sub-period from October 1994 to March 2002, they find a positive payout to profit margins with an α of 0.15.

The final variable examined is the trailing 12-month returns. The variable examines whether a stock's past performance impacts future performance. So, in other words,

do winners continue to win or do past losers become future winners. Daynes *et al.* (2008) within the same UK multi-factor model, find that if the stock exceeded the index in the past than it has a positive effect on the cross-section of expected returns. The positive payout it statistically significant for both sub-periods used in the study, and is the second most important factor in explaining returns. Interestingly enough, the only more prominent factor found in this study is the excess one month return (which has a negative coefficient). Both factors together account for about 10 percent of the stocks expected return. These results support both the short-term mean reversion as well as a momentum factor.

Sorting models are often utilized in professional money management. For greater detail, Chincarini and Kim (2006) present sorting models along with advanced techniques including regression, forecasting, inclusion of economic variables, and Bayesian updating.

5. Teaching notes

This exercise provides the potential for students to apply several interesting learning outcomes. It also provides opportunities to discuss several interesting topics. Some of those topics include:

- Examine the effectiveness of stock screens and sorting techniques in building a portfolio.
- Discuss how to pick stocks in a portfolio.
- How to build a long, short, and long/short portfolio?
- Examine the performance of a portfolio versus that of the market.
- Analyze accounting variables and their potential impact on stock returns.
- How is the idea of market efficiency challenged if prior accounting variables impact stock returns?
- Discuss mutual fund and hedge fund behavior.

Before the start of the exercise is a good opportunity to discuss stock screens and stock sorting. There are a number of free-stock screening tools available online. Students are typically asked to discuss the limitations of stock screens and how sorting may be superior. For example, stock screen limitations include the potential elimination of favorable stocks that fail to meet just one of the selected criteria. Screens also tend to lack the flexibility of examining all of the variables simultaneously and the ability to apply a preferred weighting scheme to each metric. Next, the idea of stock sorting based on accounting variables should be brought up to students as a potential benefit over stock screens. Also a discussion of potential accounting variables and how they could impact stock returns should follow. This provides the opportunity to discuss the theory and intuition behind the variables and their potential impact to stock returns. The accounting metrics may include variables from categories such as liquidity, profitability, debt, size, and momentum. The Nasdaq Guru Screener is a useful way to introduce students to relatively famous investors and their respective strategies and accompanying fundamental variables used in their stock screens. The Nasdaq web site (www.nasdaq.com/reference/guru.stm) is not only an excellent source for customized screening but also some of the most famous stock screens such as Peter Lynch's P/E Growth,

Benjamin Graham's Value Investor, Validea Momentum, The Motley Fool Small-Cap Growth Investor, David Dreman's Contrarian, Martin Zweig's Conservative Growth Investor, Kenneth Fisher's Price-to-Sales Investor, and James P. O'Shaughnessy's Growth/Value Investor strategies.

Provided with this exercise is both a student version and instructor version of a spreadsheet to be used to calculate Z-scores and to form portfolios. The instructor version also provides 2007 returns, which is not provided to students. Once the exercise begins, the sorting process can be explained involving three basic steps:

(1) Convert the accounting variables into Z-scores:

$$Z_i = \frac{(Accounting\ \ Variable_{Firm} - Industry\ \ Median)}{Industry\ \ Standard\ \ Deiviation}$$

A discussion of the interpretation of the Z-score typically follows. Students are reminded that the sign of the Z-score indicates if the firm's metric is above (positive Z-score) or below (negative Z-score) the industry median. The Z-score for each variable may be used to determine the percentage of peer firm's below the individual firm's accounting measure. Suppose firm XYZ has a Z-score of 0.50 for its current ratio. The corresponding value from the standard normal (Z) table is 0.3085 which implies that approximately 30.85 percent of firms in the industry have current ratios below that of firm XYZ.

(2) The next step of the process involves applying the appropriate sign to each variable. This provides a connection with the variables discussed at the beginning. Depending on the particular investment strategy, higher or lower (above or below industry median) values may be preferred. A growth strategy would seek firms with relatively higher P/E while a value strategy seeks firms with low P/E ratios. The same analogy applies to price momentum; growth strategies will favor relatively high (positive) 52-week stock price changes and value seeks low (negative) trailing 12-month returns. Students need to determine what types of firm's they are looking for, for example, growth or value stocks and to be consistent in applying the signs to the various accounting metrics. Following a growth strategy, the student may desire firm's with high P/E, momentum, and ROE but below industry median values for debt.

For variables in which a relatively high value is preferred, no adjustment to the sign on the Z-score is necessary. Variables in which a lower value is desired, however, the sign must be reversed. For example, if firm XYZ has a high (favorable) P/E Z-score of 0.75 and a low (preferred) Z-score of -0.50 simply adding the Z-scores will result in a low total Z-score of 0.25. If the goal is to rank preferred firms by sorting the Z-scores from highest to lowest, simply adding the Z-scores without adjusting the signs will lead to erroneous results. In order to rank aggregate Z-scores, the sign must be reversed for variables where lower (below industry median) values are ideal. For XYZ the P/E of 0.75 would then be added to the D/E of $+0.50$ for a combined score of 1.25. Notice the higher score of 1.25 better represents the two, favored values where the unadjusted signs result in a low combined Z-score of 0.25 (Table V). Firm XYZ has the desirable values of both an above average P/E and below average D/E, the adjusting of the signs result in the higher Z-score objective. Students need to be reminded to switch the

signs for those variables where a below industry average value is preferred in order to combine the Z-scores in a meaningful way for purposes of ranking securities.

(3) The third step is to combine the Z-scores for accounting variables into one aggregate score in order to rank the firms overall strength. After reversing the sign on the Z-scores where a lower value is desired, the Z-scores may be added together and an average may be derived. One of the most robust features of the Z-score sorting method is that different weights may be applied to each accounting measure based on the individuals favoring of one variable over another. Adding each of the accounting metric Z-scores together and dividing by the total number of accounting metrics will result in an equally weighting the variables. One may prefer applying a greater weight to one variable over another, however, and it is a simple process to compute a weighted average. Students are encouraged to provide a rational for what the appropriate weights might be. After the Z-scores are aggregated where each firm has a single representative Z-score, the scores may then be ranked from highest to lowest. A portfolio (or sub-portfolio) may be formed entirely from the Z-score list.

There are some issues when applying the weights that need to be considered and discussed. For example, should debt ratios be given a lower weight for the technology sector due to the low to no debt levels for these firms? How should debt numbers be considered for financial firms? Perhaps, P/B ratios should replace P/E ratios for financial firms. The idiosyncrasies of each industry may be discussed along with any adjustments that should be made to factor in these issues. The instructor sorting Excel file has the weights by sector in order to facilitate any changes an instructor may wish to implement. Students can also change weights as they deem fit. At this point, a portfolio building discussion can be given to further build on to this idea. Students can discuss how and why they picked weights and portfolio strategies.

Other issues

It is worth noting that the fundamental accounting variables used for any analysis should to be adjusted to reflect the firm's sustainable, operating performance. Nonrecurring items such as restructuring costs may have a significant impact on many of the firm's ratios but are not expected to occur each year and, without the proper adjustments, will bias the results of the stock screen. Many academicians and practitioners suggest that, at a minimum, the firm's accounting statements should be adjusted to reflect its core earnings (see www.standardandpoors.com for a definition of core earnings). Another major topic within this paper is the idea of market efficiency. If publicly know accounting variables help explain returns than the idea of market efficiency is challenged. This provides a good entry point to discuss the idea of market efficiency and potential issues with market efficiency.

	Firm XYZ		
	P/E	D/E	Combined Z-score
Unadjusted Z-score	0.75	− 0.50	0.25
Adjusted Z-score	0.75	0.50	1.25

Table V.

Finally, for instances where the accounting data for a firm are missing or N/A, it is important that students recognize that replacing it with a value of zero is the equivalent of that firm's metric being equal to the industry average value. Missing values or errors are better handled by changing the weight on that item to zero, for example.

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