

## Portfolio Construction Using Key Fundamental Ratios and the DJIA Stocks

Thomas M. Krueger and Mark A. Wrolstad

### Abstract

Index funds have attracted investors over the years by promising to lower fees, turnover, taxes, and other expenses while outperforming the average actively-managed fund. Portfolio indexation has historically focused on three main methods of portfolio weighting: price-weighting, market capitalization-weighting, and occasionally equal-weighting. More recently, attention has been focused on “fundamental weighting” using financial statement items like sales, total assets, EBIT, and dividends to weight stock portfolios. This research focuses on portfolios of the 30 Dow Jones Industrial Average (DJIA) stocks that are constructed using 15 different metrics. Two of the methods of indexation are the traditional approaches of price and market capitalization and the other 13 methods of indexation are ratios based upon the DuPont equation, price relatives, and operating cash flows. After the decade studied, the portfolio with the highest terminal value for the \$1000 originally invested was the \$1198 of the Operating Cash Flow (OCF) / Current Liabilities indexed portfolio and the lowest terminal value was the \$670 for the Price/Sales indexed portfolio. The OCF / Current Liabilities, OCF / Total Debt, and OCF / Net Income-based portfolios all show significantly better performance at the 2% to 5% level when compared to the market value-weighted portfolio. None of these ratios had an abnormal level of skewness or kurtosis, which would have minimized the implications of these findings. Across the financial statements, the cash flow statement appears to provide the most fertile ground for above average rates of return to the passive, long-term investor.

### I. Literature Review

The basic approaches to portfolio creation have been used for some time. Price-weighting is used for the DJIA, market capitalization-weighting is used for the NASDAQ Composite and Russell 2000 Indexes, and equal-weighting is used for the Value Line Index. In comparing these three approaches, Krueger & Wrolstad (2010) found that an equal-weighted portfolio of DJIA stocks performed the best during the period from 1999 to 2009. The initial investment of \$1,000 in the equal-weighted portfolio grew to \$1,020 during that volatile decade while the price-weighted portfolio declined in value to \$777 and the market capitalization-weighted portfolio declined even further to \$731.

A study by Arnot, Hsu, & Moore (2005) found that fundamental indexes outperformed the market capitalization-weighted Standard & Poor's 500 (S&P 500) Index by approximately 2% annually between 1962 and 2004. Studying geometric average returns, McQuarrie (2008) found that an equal-weighted S&P 500 Index outperformed the Research Affiliates Fundamental 1000 Index (RAFI) by 13.11% versus 12.47% while the S&P 500 itself had a return of only 10.39%. The RAFI weights companies by four factors: book equity value, free cash flow, total cash dividends, and total sales.

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Thomas M. Krueger, DBA is Director of Research and Professor of Finance, Texas A&M-Kingsville, [thomas.krueger@tamuk.edu](mailto:thomas.krueger@tamuk.edu). and Mark A. Wrolstad, Ph.D. is Professor of Finance, Winona State University, Winona, Minnesota, [mwrolstad@winona.edu](mailto:mwrolstad@winona.edu).

Since the favorable investment results of using fundamental factors to index portfolios cited above became more widely known, there has been controversy concerning the use of

income statement and balance sheet accounts to index portfolios. Hsu (2006) suggests that the return drag in capitalization-weighted portfolios is driven entirely by capitalization weighting's tendency to overweight the overvalued stocks and underweight the undervalued stocks. In an article critical of fundamental weighting, Perold (2007) suggests that fundamental indexing is really only an active security selection technique which relies upon investing in value stocks. Kaplan (2008) tries to reconcile these two perspectives by suggesting that both market capitalization and fundamental variables contain information about fair market values and that they can be combined to form portfolio weights that reflect the information contained in each.

Still another approach is to use ratios created from financial statement values to enhance stock returns and/or index portfolios. Examples of papers using financial ratios include a study by Fama & French (1995) which found that the book/market value (B/MV) ratio variable had the strongest relationship with stock returns of the variables they tested. In a subsequent investigation using S&P 500 industry-level data, Kothari et al. (1995) did not find any significant relationship between the B/MV ratio and stock returns. The study by Barbee et al. (1996) found that the annual sales per share/common stock price (S/P) ratio was the only variable that consistently had a significant role in explaining stock returns in their models. Still another example of using ratios is the work done by Mills and Yamamura (1998) where they extol the use of a variety of cash flow ratios to help people gauge a company's viability and ability to withstand cyclical downturns or price wars. Regardless of the portfolio construction method used, Bailey (1992) offers good advice in suggesting that the chosen criteria for indexing a portfolio be unambiguous, investable, measurable, and appropriate. This study considers some of the ratios mentioned above as well as the DuPont equation ratios and a variety of cash flow ratios. Our goal is to identify measures that could be employed by investors interested in optimizing portfolio performance given a predetermined set of companies in their portfolio. By limiting the sample to a specific, well-known sample of stocks, we exclude the confounding effects arising from inclusion of uncommon, unique firms and can focus our analysis on the process of portfolio construction.

## **II. Data and Methodology**

Table I presents a listing of the companies which were members of the Dow Jones Industrial Average during the decade studied. As can be seen, the DJIA membership is quite stable with over three-fourths of the thirty companies in the index for the entire ten-year sample period which runs from 1999 through 2009. Most of the membership volatility that does occur coincided with the recession in the latter part of the sample period. To deal with membership changes, sample membership is updated on an annual basis. The replacement company is assumed to be in place for the whole year in which it replaces another company that is dropped out of the index. For instance, on March 8, 2004, Kodak and International Paper were replaced by Pfizer and Verizon. Year-end 2003 financial statement values for Pfizer and Verizon are used for portfolio allocation purposes in the year 2004. As a consequence, the returns presented in this paper will vary slightly from those presented in the financial press for the DJIA. Median returns are presented because the mean portfolio returns are based upon only ten annual returns.

Total returns serve as the independent variable. Price and dividend data were obtained from finance.yahoo.com. Data used in the allocation process were primarily obtained from Morningstar.com. Missing data were obtained from the individual company financial statements. Fifteen portfolios are created in total. Two of them are weighted upon the traditional allocation models of price and market capitalization. To make the returns of the various methods more comparable, dividends have been added to the returns of the price-weighted DJIA.

<b>Table I - DJIA Membership</b>			
<b>Stock in DJIA for Entire Decade</b>			
3M Company	Coca-Cola	Intel	Microsoft
Alcoa Incorporated	DuPont	IBM	Procter & Gamble
American Express	Exxon Mobile	Johnson & Johnson	United Technologies
AT&T	General Electric	J.P. Morgan	Walmart
Boeing	Home Depot	McDonalds	Walt Disney
Caterpillar	Hewlett-Packard	Merck	
<b>Changes in DJIA Membership</b>			
On 4/8/04	Kodak & International Paper	Replaced by	Pfizer & Verizon
On 2/19/08	Altria & Honeywell	Replaced by	Bank America & Chevron
On 9/22/08	AIG	Replaced by	Kraft
On 6/8/2009	Citigroup & General Motors	Replaced by	Travelers & Cisco

In most cases, the observed value of the allocation variables is positive in all periods. For example, firms always have positive price, sales, and total assets levels. When no dividends are paid, no allocation is made to the company on the basis of that metric. In instances where an independent variable is negative (i.e., net income), it was assumed that the portfolio shorted the weighting of this DJIA member.

Portfolio return statistics were measured using Microsoft's Excel statistical package, which provides direct evidence of mean significance using z-tests and t-tests. Like return means, skewness and kurtosis measures are seldom zero. However, Excel does not present a direct measure of the significance of skewness and kurtosis estimates. One commonly used technique to test for skewness consist of determining whether the skewness values are more than two standard errors of skew. Tabachnick and Fidell (1996) report that the standard error of skew can be estimated as  $\sqrt{(6/n)}$ , which for a sample of ten years would be  $\sqrt{(6/10)}$ , or 0.775. Doubling this value results in a critical value of 1.55 for skewnewss. Tabachnick and Fidell (1996) also state that the standard error of kurtosis estimated as  $\sqrt{(24/n)}$ , which for a sample of ten years would be  $\sqrt{(24/10)}$ , or 1.549. Doubling this value results in a critical value of 3.098 for kurtosis. Bell (2010a, 2010b) provides a clear explanation of the application of skewness and kurtosis for anyone seeking additional insight to these measures. Taylor (2008) provides a specific application of skewness (p. 44) and kurtosis (p. 47) for financial time series modeling.

### III. Results

The next three tables provide an analysis of the return and risk resulting from portfolios that vary by the way in which the money invested in the thirty companies of the DJIA is allocated. Each of these tables begins with the performance of the traditional price-weighted and value-weighted portfolios. Table II compares the performance of these traditional portfolios to portfolios whose allocations are based upon the Du Pont Equation components of profit margin, total asset turnover, equity multiplier, and the return on equity. In Table II, we see that over the 2000-2009 decade, using the equity multiplier would have resulted in a mean rate of return of 4.0 percent. The highest median was registered by the price-weighted DJIA. By comparison, the capitalization-weighted Dow index, an "S&P 30" if you will, had the only negative mean and median values.

The capitalization-weighted portfolio had the lowest maximum return and the total asset turnover-weighted portfolio registered the lowest loss in 2008, which was the worst year for all indexes. By comparison, the best and worst single year was experienced by the portfolio based on the equity multiplier. Therefore, it is not surprising that the equity multiplier based portfolio has the greatest standard deviation. In fact, the equity multiplier's standard deviation is over fifty percent greater than the standard deviation of the total asset turnover-based portfolio which was the lowest. Low skewness and kurtosis values indicate that the return distributions did not significantly deviate from a normal "bell-shaped" distribution. The final row of Table II demonstrates that seemingly low variations can result in large differences in terms of ending portfolio values. The total asset turnover-indexed portfolio registered a positive gain of \$112 and the capitalization-weighted portfolio lost \$270 by December 2009. Consistent with the difference in ending monetary values, the asset turnover-weighted portfolio's geometric return is 1.07 percent and the capitalization-weighted portfolio's geometric return is -3.10 percent. This represents an annual difference of 4.17 percent.

Table II Comparative Performance of Portfolios Based on Du Pont Analysis Components						
	Common Market Index Weightings Schemes		Weightings based on Du Pont Analysis Components			
	Price	Capitalization	Profit Margin	Asset Turnover	Equity Multiplier	Return on Equity
Mean	2.5	-1.7	1.0	2.4	4.0	0.2
Median	3.5	-0.4	0.7	1.6	0.1	0.9
Maximum	28.3	18.7	24.2	24.2	42.5	23.2
Minimum	-31.9	-29.0	-30.3	-26.4	-43.5	-39.9
Std Deviation	17.9	17.0	17.1	16.8	26.7	18.5
Skewness	-0.3	-0.2	-0.2	-0.1	-0.0	1.9
Kurtosis	0.4	-1.2	-0.6	-0.6	0.4	-1.1
Terminal value of initial \$1000 investment	\$1105	\$730	\$959	\$1112	\$1073	\$855

Table III examines portfolio creation using some popular price relative ratios. For ease of reading, the first two columns found in Table II are repeated in the next two tables. As the reader may have expected after looking at the ratios considered, Table III demonstrates the disadvantage of investing in companies with a high price. At least one value in the first two rows for each price relative is negative. The lowest return was obtained by investing in a portfolio based upon the price/sales ratio which had an average loss of 2.1 percent and a median loss of 1.4 percent. Although price/book and price/dividends ratios showed a small mean gain, their median returns are both losses of over two percent. In fact, this table shows that only the price-weighted portfolio ended up with both a positive mean and median returns. Our price-weighted DJIA exceeds the Dow's performance reported in the financial press due to our inclusion of the healthy dividends paid by these thirty mature companies.

The best single annual return was registered by the price/dividends ratio, which gained 36.0 percent in 2003. Portfolios based on the price/dividends, price/earnings, and price/sales ratios all lost about thirty-two percent in 2008. Although the price/free cash flow weighted portfolio lost 26.9 percent in 2008, it was the least impacted by the market selloff. Standard deviations were found to be within a relatively narrow band, running from 17.0 percent for the capitalization-weighted portfolio to 21.4 percent for the price/dividends-weighted portfolio. At \$670, or a loss of \$330, the price/sales based portfolio would have lost the most of any portfolio in this study over the 2000-2009 periods.

Table 3 exhibits the only instance in which portfolio return has a significantly skewed and peaked distribution. The negative skewness arises from a large negative return in 2008. Firms with higher price/earnings ratios experienced a large decline in value that year.

Excluding this year, as witnessed by the high kurtosis value, the returns were closely bunched around the mean return for a portfolio based on firm price/earnings ratios.

	Common Market Index Weighting Schemes		Weightings Based on Price Relatives				
	Price	Capitalization	<u>Price</u> Book Value	<u>Price</u> Dividends	<u>Price</u> Earnings	<u>Price</u> Free Cash Flow	<u>Price</u> Sales
Mean	2.5	-1.7	0.1	0.7	-0.8	-0.3	-2.1
Median	3.5	-0.4	-2.7	-2.3	-1.4	1.7	-1.4
Maximum	28.3	18.7	27.6	36.0	22.9	22.4	27.0
Minimum	-31.9	-29.0	-30.2	-32.2	-32.4	-26.9	-32.9
Std. Deviation	17.9	17.0	18.1	21.4	18.4	18.9	19.5
Skewness	-0.3	-0.2	-0.2	0.4	-1.9	0.4	-0.4
Kurtosis	0.4	-1.2	-0.5	-0.0	4.52	0.6	-0.9
Terminal Value Of The Initial \$1000 Invested	\$1105	\$730	\$864	\$875	\$918	\$819	\$670

Portfolio indexation using operating cash flow (OCF) values divided by current liabilities, total debt, sales, and total stockholder's equity are presented in Table IV. We have chosen OCF because it is the lifeblood of a company and one of the most important barometers that investors have. Among the advantages of selecting OCF is that operating cash flow is harder to manipulate under GAAP than net income (although it can be done to a certain degree). Another reason for selecting it is simply the importance of cash to a firm and the fact that any company that does not generate cash over the long-term is on its deathbed. A company can live with negative cash flows for a limited period of time. Eventually the company will need to pay their suppliers and bankers. Many companies have gone bankrupt because they could not generate enough cash.

Unlike the price relatives, each of the operating cash flow ratios has a positive mean and median return. With a mean return of 3.3 percent, the OCF/Current Liabilities ratio-based portfolio had the second highest average return after the 4.0 percent of the to the equity multiplier-based portfolio found in Table II.

Although the price-weighted portfolio outperformed all operating cash flow-based portfolios in terms of median income and maximum income, it performed more poorly in 2008 than all of the other portfolios in Table IV. Return standard deviations again fall in a relatively narrow band, running from 16.7 percent to 18.1 percent, with none of the skewness or kurtosis measures being statistically significant. The highest terminal value in this entire study was the \$1198 observed in the OCF/Current Liabilities portfolio. It should also be pointed out that all OCF-based ratios ended up with a terminal value exceeding the initial \$1000.

Table IV Comparative Value of Operating Cash Flow Ratios						
	Common Index Schemes	Market Weighting	Weighting Based on Popular Operating Cash Flow Ratios			
	Price- weighted	Value Weighted	<u>Operating Cash Flow</u> Current Liabilities	<u>Operating Cash Flow</u> Total Debt	<u>Operating Cash Flow</u> Sales	<u>Operating Cash Flow</u> Stockholders' Equity
Mean	2.5	-1.7	3.3	1.9	2.0	2.4
Median	3.5	-0.4	0.9	0.2	0.2	1.5
Maximum	28.3	18.7	26.5	24.2	22.4	26.8
Minimum	-31.9	-29.0	-25.6	-26.8	-29.7	-28.1
Std Deviation	17.9	17.0	18.1	17.7	17.7	16.7
Skewness	-0.3	-0.2	-0.1	-0.2	-1.4	-0.6
Kurtosis	0.4	-1.2	-1.0	-0.8	2.5	1.3
Terminal Value of the Initial \$1000 Invested	\$1105	\$730	\$1198	\$1041	\$1057	\$1123

The performances of the fifteen portfolios found in Tables II to IV vary by the way in which wealth is allocated to the thirty companies in the Dow Jones Industrial Average. The key issue we want to address is whether any measure considered in this research can be used for indexing a portfolio in order to earn statistically significant, positive returns. A related concern is whether any of these approaches for indexing a portfolio can provide a higher return than the market portfolio. Given the poor performance of stock market investments during the last decade, beating the market becomes an important concern.

In order to determine whether returns were statistically different from zero, z-statistics were calculated and exhibited in the first numerical data column of Table V. Given the 2000 dot-com bust, 9/11/2001 terrorist attacks, and financial crisis of 2007-2009, it is not surprising that none of the measures provide a significant z-statistic. One less obvious implication of insignificant z statistics is that investors cannot use the financial ratios presented here in a

short-selling strategy to earn returns that are significantly greater than zero despite some seemingly large drops in terminal values.

Since market capitalization-based indexation is currently the predominant investment industry method, the other 14 portfolios are compared to it in the second numerical data column in Table V. Both the dividend-enhanced price-weighted and the profit margin-weighted portfolios performed statistically different from the market capitalization-weighted portfolio at the 0.10 level. Looking back at the mean returns reported in Table II, we can conclude that these indexation techniques slightly outperformed the capitalization method.

Table V. Analysis of Statistical Significance			
z-test - "Is the mean return statistically different from zero?"			
t-test - "Is the return distribution statistically different?"			
		<u>z-</u> <u>statistic</u>	<u>t-statistic</u>
Traditional Weighting	Price-weighted	0.328	0.062*
	Mkt. Cap.-weighted	0.624	n/a
Du Pont Analysis Measures	Profit Margin	0.429	0.061*
	Asset Turnover	0.328	0.560
	Equity Multiplier	0.317	0.201
	Return on Equity	0.484	0.485
Price Relatives	Price/ Book Value	0.495	0.193
	Price/ Dividends	0.465	0.374
	Price/Earnings	0.448	0.113
	Price/ Free Cash Flow	0.520	0.627
	Price/Sales	0.633	0.815
Operating Cash Flow Ratios	OCF/ Current Liabilities	0.282	0.017**
	OCF/ Total Debt	0.370	0.044**
	OCF / Net Income	0.358	0.018**
	OCF / Stockholders Equity	0.322	0.123

Key: \* = 0.10, \*\* = 0.05

The portfolios with greater statistical significance were some of the OCF-based models. As shown in the bottom right corner of Table V, returns using OCF/Current Liabilities and OCF/Net Income were significant at the 0.02 level. Double-checking the mean

returns found on Table IV, we can be confident that these indexation techniques outperformed the market capitalization method. Portfolio returns using the OCF/Total Debt was also significant at the 0.05 level. Given the limitations of this study--use of annual data, the most recent (volatile) decade, and only thirty companies--such high levels of statistical significance are impressive. Even if the next decade is as volatile as the last, additional data from future years will increase the degrees of freedom and may push the statistical significance level of these comparisons even higher.

#### **IV. Summary and Conclusions**

This research focuses on portfolios of the thirty DJIA stocks that are indexed using 15 different metrics. Two of the methods of indexation are the traditional approaches of price and market capitalization used in the DJIA and S&P 500, respectively. The other 13 methods of indexation are ratios based upon the DuPont equation, price relatives, and operating cash flows.

After the decade studied, the portfolio with the highest terminal value for the \$1000 originally invested was the \$1198 of the OCF/Current Liabilities portfolio and the lowest terminal value was the \$670 for the Price/Sales indexed portfolio. The best single year performance for any of the portfolios was the 42.5% return of the equity multiplier-based portfolio and the worst yearly performance was the loss of 43.5% of the same portfolio. Given its leverage-related magnification effect, it is not a surprise that the equity multiplier-based portfolio returns had the highest standard deviation of 26.7%. The OCF/Stockholders Equity had the lowest standard deviation at 16.7%.

Our limited sample size did not permit us to show that the abnormal performance of our portfolios were significantly different from zero. We were able to show statistical significance when comparing the rest of our portfolios to the market capitalization-indexed portfolio. Specifically, the OCF/Current Liabilities, OCF/Total Debt, and OCF/Net Income-based portfolios all show significantly different performance at the 2% to 5% level when compared to the market value-weighted portfolio. Across the financial statements, over this period and based on financial statement information studied here, the cash flow statement appears to provide the most fertile ground for above average rates of return to the passive, long-term investor. The average terminal value for portfolios based on cash flow statement values exceeded the income statement-based portfolio's average terminal value by \$35 and the balance sheet-based portfolio's average terminal value by \$180.

These findings have important implications for the investors. Despite the limited coverage of cash flow statement ratios in popular textbooks, cash flow statement ratios appear to provide significant investment opportunities. They can be used by investors at all levels, from the individual to the hedge fund manager, increasing the former's return and the latter's performance-based bonus. For the researcher, these findings challenge the concept of market efficiency and open up new venues for the study of abnormal returns.

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