Why Does an Equal-Weighted Portfolio Outperform Value- and Price-Weighted Portfolios

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Abstract

We compare the performance of equal-, value-, and price-weighted portfolios of stocks in the major U.S. equity indices over the last four decades. We find that the equal-weighted portfolio with monthly rebalancing outperforms the value- and price-weighted portfolios in terms of total mean return, four factor alpha, Sharpe ratio, and certainty-equivalent return, even though the equal-weighted portfolio has greater portfolio risk. The total return of the equal-weighted portfolio exceeds that of the value- and price-weighted because the equal-weighted portfolio has both a higher return for bearing systematic risk and a higher alpha measured using the four-factor model. The nonparametric monotonicity relation test indicates that the differences in the *total return* of the equal-weighted portfolio and the value- and price-weighted portfolios is monotonically related to size, price, liquidity and idiosyncratic volatility. The higher *systematic return* of the equal-weighted portfolio arises from its higher exposure to the market, size, and value factors. The higher *alpha* of the equal-weighted portfolio arises from the monthly rebalancing required to maintain equal weights, which is a contrarian strategy that exploits reversal and idiosyncratic volatility of the stock returns; thus, alpha depends only on the monthly rebalancing and *not* on the choice of initial weights.

Keywords: stock index, systematic risk, idiosyncratic risk, factor models, contrarian, trend following

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1. Introduction

It is important to understand the difference in performance of the equal- and value-weighted portfolios given the central role that the value-weighted market portfolio plays in asset pricing, for instance in the Capital Asset Pricing Model of Sharpe (1964), and also as a benchmark against which portfolio managers are evaluated.[1] Our work is motivated by the finding in DeMiguel, Garlappi, and Uppal (2009) that the out-of-sample performance of an equal-weighted portfolio of stocks is significantly better than that of a value-weighted portfolio, and no worse than that of portfolios from a number of optimal portfolio selection models; Jacobs, Muller, and Weber (2010) extend this finding to other datasets and asset classes. Our objective in this paper is to compare the performance of the equal-weighted portfolio relative to the value- and price-weighted portfolios, and to understand the reasons for differences in performance across these three weighting rules. Our main contribution is to show that there are significant differences in the performance of equal-, value-, and price-weighted portfolios, and to explain that only a part of this is because of differences in exposure to systematic risk factors, and that a substantial proportion comes from the rebalancing required by the equal-weight portfolio.

To undertake our analysis, we construct equal-, value-, and price-weighted portfolios from 100 stocks randomly selected from the constituents of the S&P500 index over the last 40 years. We find that the equal-weighted portfolio with monthly rebalancing outperforms the value- and price-weighted portfolios in terms of total mean return and four-factor alpha from the Fama and French (1993) and Carhart (1997) models. The total return of the equal-weighted portfolio is higher than that of the value- and price-weighted portfolios by 271 and 112 basis points per annum. The four-factor alpha of the equal-weighted portfolio is 175 basis points per year, which is more that 2.5 times the 60 and 67 basis points per year for the value- and price- weighted portfolios, respectively. The differences in total mean return and alpha are significant even after allowing for transactions costs of 50 basis points.

The equal-weighted portfolio, however, has a higher volatility (standard deviation) and kurtosis compared to the value- and price-weighted portfolios. The volatility of the return on the equal-weighted portfolio is 17.90% per annum, which is higher than the 15.83% and 16.46% for the value- and price-weighted portfolios; the kurtosis of 5.53 for the equal-weighted portfolio is also higher than the 4.83 and 5.36 for the value- and price-weighted portfolios. The skewness of the equal-weighted portfolio is less negative than the skewness of the value- and price-weighted portfolios: the skewness of the equal-weighted portfolio is −0.3266, compared to −0.3860 and −0.4996 for the value- and price-weighted portfolios, respectively.

Despite the unfavorable volatility and kurtosis, the Sharpe ratio and certainty-equivalent return of the equal-weighted portfolio are higher than those of the value- and price-weighted portfolios. The Sharpe ratio of the equal-weighted portfolio is 0.4275, while that for the value- and price-weighted portfolios is 0.3126 and 0.3966. The higher return and less negative skewness of the equal-weighted portfolio leads also to a higher certainty-equivalent return, which, for an investor with power utility and relative risk aversion of 2, is 0.0994 per annum for the equal-weighted portfolio, compared to 0.0793 and 0.0930 for the value- and price-weighted portfolios, respectively.

The results described above imply that the source of the superior performance of the equal-weighted portfolio is its significantly higher mean return, along with its less-negatively skewed returns. To understand the reasons for the superior performance of the equal-weighted portfolio, we first use the non-parametric monotonicity relation tests developed by Patton and Timmermann (2010) and Romano and Wolf (2011) to study if there is a relation between a particular characteristic of stocks and the *total return* of the equal-weighted portfolio relative to the value- and price-weighted portfolios.[2] These monotonicity tests indicate that the returns of

1 - For a discussion of the traditional capitalization-weighted portfolio as a benchmark, and alternatives to this benchmark, see Amenc, Goltz, and Martellini (2011), Amenc, Goltz, Martellini, and Retkowsky (2010), Arnott, Hsu, and Moore (2005), Chow, Hsu, Kalesnik, and Little (2011), Grinold (1992), Haugen and Baker (1991), and Martellini (2009).

2 - There is a large literature studying the relation between returns and characteristics of sort-based portfolios; see, for example, Conrad, Cooper, and Kaul (2003).

the equal-weighted portfolios relative to the returns of the value- and price-weighted portfolios are monotonically decreasing with size and price, and monotonically increasing with idiosyncratic volatility. Liquidity is monotonically related to the difference in returns between only the equal- and value-weighted portfolios, while book-to-market is related to the difference in returns between only the equal- and price-weighted portfolios. Reversal and 3-month momentum are not significantly monotonically related to the returns of the equal-weighted portfolio relative to the value- and price-weighted portfolios, although it is the stocks with extremely low and extremely high reversal that contribute to the higher alpha of the equal-weighted portfolio.

Motivated by the ndings from the non-parametric monotonicity tests, we use the standard four-factor model (Fama and French (1993) and Carhart (1997)) to decompose the total returns of the equal-, value-, and price-weighted portfolios into a *systematic component*, which is related to factor exposure, and *alpha*, which is not related to factor exposure. We find that of the total excess mean return of 271 basis points per annum earned by the equal-weighted portfolio over the value-weighted portfolio, 42% comes from the difference in alpha and 58% from the excess systematic component. On the other hand, of the total excess mean return of 112 basis points earned by the equal-weighted portfolio relative to the price-weighted portfolio, 96% comes from the difference in alpha and only 4% from the difference in systematic return. The proportional split between systematic return and alpha is similar also after adjusting for transactions costs of 50 basis points. We find that the higher systematic return of the equal-weighted portfolio arises from its higher exposure to the market, size, and value factors; however, the equal-weighted portfolio has a more negative exposure to the momentum factor than the value- and price-weighted portfolios. We also extend the four-factor model by including the systematic reversal factor (constructed by K. French and available on his web site) and find that 11% of the four-factor alpha of the equal-weighted portfolio can be attributed to the exposure to the reversal factor. However, including the reversal factor does not affect the alphas of the value-and price-weighted portfolios, both of which stay insignificant.

Finally, we demonstrate through two experiments that the higher alpha and less negative skewness of the equal-weighted portfolio are a consequence of the monthly rebalancing to maintain equal weights, which is implicitly a contrarian strategy that exploits the reversal in stock prices at the monthly frequency.[3] In the first experiment, we reduce the rebalancing frequency of the equal-weighted portfolio. We find that as the rebalancing frequency decreases from 1 month to 6 months, the excess alpha earned by the equal-weighted portfolio decreases and the skewness of the portfolio return becomes more negative; when the rebalancing frequency is further reduced to 12 months, the alpha of the equal-weighted strategy is indistinguishable from that of the value- and price-weighted strategies. In the second experiment, we artificially keep the weights of the value- and price-weighted portfolios fixed so that they have the contrarian flavor of the equal-weighted portfolio, and we find that this increases their alpha and makes skewness less negative. If we keep the weights of the value- and price-weighted strategies fixed for 12 months, the alpha of these portfolios increases and is indistinguishable from that of the equal-weighted portfolio. An important insight from these two experiments is that it is not the initial weights of the equal-weighted portfolio, but the monthly rebalancing that is responsible for the alpha it earns, relative to the alphas for the value- and price-weighted portfolios. This is explained, at least partly, by the theoretical results of Platen and Rendek (2010), who show that with continuous rebalancing the equal-weighted portfolio approaches the optimal growth portfolio of a log-utility investor, and hence, outperforms other portfolios including the value-weighted portfolio.

We check the robustness of our results along a variety of dimensions. When selecting a sample of stocks from the S&P500 index, we consider not just one portfolio with 100 stocks but resample to select 1,000 portfolios, and all the results we report are based on the returns averaged across

3- For the literature on momentum and contrarian strategies, see Jegadeesh (1990), Conrad and Kaul (1998), Jegadeesh and Titman (1993, 2002), Lo and MacKinlay (1990), DeMiguel, Nogales, and Uppal (2010) and Asness, Moskowitz, and Pedersen (2009).

these 1,000 portfolios. In addition to the results reported for portfolios with 100 stocks, we also consider portfolios with 30, 50, 200, and 300 stocks (again, with resampling over 1,000 portfolios). Besides the stocks sampled from the S&P500 for large-cap stocks, we consider also stocks from the S&P400 for mid-cap, and the S&P600 for small-cap stocks. We also carry out a number of tests using simulated data. Finally, we test the sensitivity of our results to different economic conditions: we study the performance of the equal-weighted portfolio relative to the value- and price-weighted portfolios if one had invested in the strategy at the peak of the business cycle (March 2001 or December 2007) or the trough (November 2001). We find that our results are robust to all these variations.

The rest of the paper is organized as follows. In Section 2, we describe the data on stocks that we use to build the portfolios we study, the resampling procedure, and the performance metrics used to compare the performance of equal-, value-, and price-weighted portfolios. In Section 3, we provide evidence on the empirical performance of the three weighting rules. In Section 4, we use the nonparametric monotonicity relatio test to identify the stock characteristics are related to the differences in the returns of the equal-weighted portfolio and the value- and price-weighted portfolios. In Section 5, we study the returns of the equal-, value-, and price-weighted portfolios using the four-factor model; Section 5.1 analyzes the systematic exposure of returns, and Section 5.2 investigates the source of the excess alpha of the equal-weighted portfolio, relative to the alphas of the value- and price-weighted portfolios. The robustness tests we undertake are described in Section 6. We conclude in Section 7 with a short summary of the findings. Appendix A explains the data and the resampling technique used to compute the test statistics; Appendix B gives the details of the construction of the various stock characteristics that we use in our analysis.

2. Data Description and Methodology

In this section, we first describe our data. Next, we describe the resampling procedure used to construct 1,000 portfolios so that the results do not depend on a particular sample of stocks. Finally, we describe the performance metrics used to compare the out-of-sample performance of the equal-, value-, and price-weighted portfolios.

2.1 The Choice of Stocks

We construct equal-, value-, and price-weighted portfolios of N = 100 stocks that are in the S&P500 index over the period February 1967 to December of 2009. For robustness, we also consider (i) portfolios with 30, 50, 200, and 300 stocks; and, (ii) stocks belonging to the MidCap S&P400 index from July 1991 to December of 2009, and the SmallCap S&P600 index from November 1994 to December of 2009. The choice of starting month is dictated by the date on which each particular index was initiated. In total, the stocks in our sample cover approximately 90% of the market capitalization of stocks traded in the U.S. stock market. The S&P500 index focuses on the large-cap segment of the market with coverage of more than 75% of U.S. equities. The other two indices cover about 10% of the market.

To identify the composition of the index at any point in time we use the COMPUSTAT Index Constituents file and link it to the CRSP file using the CCM (CRSP/COMPUSTAT Merged Database) Linking Table. For each portfolio with N stocks, we randomly choose N stocks that are constituents of a particular index. If the S&P announces the decision to remove a particular stock that was in our portfolio (the S&P usually makes this announcement five days before removing the stock), then we too remove this stock from our portfolio and randomly choose another stock to replace it.

We use monthly returns in our analysis and the data on returns for stocks is extracted from the CRSP database. The company characteristics used in our analysis, such as size, book-to-market, momentum, reversal, liquidity, and idiosyncratic volatility, are constructed using the monthly and daily CRSP and COMPUSTAT databases. We describe the data filtering steps in Appendix A and the method for constructing each characteristic in Appendix B.

2.2 Resampling Procedure and Performance Metrics

We study three commonly used weighting rules: equal-weighting, price-weighting, and value-weighting. To ensure that our results are not driven by the choice of stocks that we select from a particular index, rather than studying just one sample of stocks, we use resampling to form 1, 000 randomly chosen portfolios of a given size N from a given stock index, and compute the performance metrics for each portfolio-weighting rule. We then use the resulting empirical distribution of the metrics to compute the p-values to test the null hypotheses that there is no difference in the value of each performance metric for the equal-weighted portfolio and the value-weighted portfolio, and for the equal-weighted portfolio and the price-weighted portfolio.

We compute a number of performance metrics for the returns on the equal-, value-, and price-weighted portfolios. The performance metrics we compute can be divided into three broad groups. First, for return indicators, we use the mean return on the portfolio, the systematic return on the portfolio based on the four-factor model (Fama and French (1993) and Carhart (1997)), and the alpha with respect to the one-factor market model and the four-factor model. We also compute the *outperformance frequency*, which is the average fraction of times that the equal-weighted portfolio has a higher cumulative return than the value- and price-weighted portfolios within a 12-month period from the beginning of each period.

Second, for measuring the risk of the portfolio return, we compute the volatility (standard deviation), skewness, and kurtosis of the portfolio return, as well as the average maximum drawdown (MDD), defined as the time series average of the maximum percentage loss of the portfolio value $V(\tau)$ over any period from τ_1 to τ_2 during the last twelve months:

$$\text{MDD} = \frac{1}{T-13}\sum_{t=12}^{T-1} \max_{t-11\leq\tau_1<\tau_2\leq t} \left\{0, \frac{V(\tau_1)}{V(\tau_2)} - 1\right\} \times 100. \tag{1}$$

Third, to measure the risk-return tradeoff we use the Sharpe ratio, Sortino ratio, and Treynor ratio. The Sharpe ratio is measured as the mean return in excess of the risk-free rate divided by the volatility of the portfolio. The Sortino ratio is measured as the mean return in excess of the risk-free rate, divided by the downward semi deviation DR of the portfolio return from the risk-free rate, where

$$DR = \sqrt{\frac{1}{T}\sum_{i=1}^{T}(\max\{r_i^f - r_i, 0\})^2}. \tag{2}$$

Compared to the Sharpe ratio, Sortino ratio penalizes only the downward deviations of the portfolio return from the target risk-free rate. The Treynor ratio (also called the reward-to-volatility ratio), is measured as the mean return in excess of the risk-free rate divided by the portfolio's one-factor market beta, β^{mkt}. According to the Treynor ratio, portfolios with the similar systematic return components will achieve similar rankings. We also report the certainty equivalent return of a myopic CRRA investor for two levels of relative risk aversion: $\gamma = 2$ and $\gamma = 5$.

We report the annual turnover of each portfolio. We define the *monthly* turnover to be the time-series mean (over the $T-1$ monthly rebalancing dates) of the sum of absolute changes in weights across the N available stocks in the portfolio:

$$\text{Turnover} = \frac{1}{T-1}\sum_{t=1}^{T-1}\sum_{j=1}^{N}\left(\left|w_{j,t+1} - w_{j,t^+}\right|\right). \tag{3}$$

To get the annual turnover, we multiply the above quantity by 12. Note that, in contrast to the definition usually used in the mutual-fund industry, our measure includes both sales and purchases; so, compared to the traditional measure, our measure of turnover is twice as large. We also compute the Euclidean distance (2-norm) between the pairs of the portfolio weights, which measures how different are the weights in the equal-weighted portfolio from the weights in the value- and price-weighted portfolios.

$$\text{Distance}_{i,j} = \frac{1}{T}\sum_{t=1}^{T}\sqrt{\sum_{n=1}^{N}(w_n^i - w_n^j)^2}. \quad (4)$$

If two portfolios have almost the same portfolio weights, the distance between their weights will be almost zero; the more portfolios differ from each other, the bigger will be the distance between their weights. Also, the distance between a concentrated and a well-diversied portfolio will be greater than the distance between two less concentrated portfolios. We compute all the performance metrics described above both, before transactions costs, and net of a proportional trading cost of 50 basis points (0.5%). The annual transactions costs for our portfolio are obtained by multiplying the annual turnover by 50 basis points. The mean return net of transactions costs is then obtained by subtracting these transaction costs from the total mean return before transactions costs.

3. Performance of Equal-, Value-, and Price-Weighted Portfolios

We now analyze how different weighting rules affect portfolio performance. The performance that we report in this section is based on the average metrics from the 1,000 portfolios constructed for each portfolio-weighting rule, as described in Section 2.2. We measure the performance of each of the three weighting rules over the period February 1967 to December 2009 for the stocks constituents of S&P500. We report in Table 1 performance measured in per annum terms. We study performance before transactions costs and also performance net of transactions costs of 50 basis points.[4] We divide our discussion of portfolio performance into three parts, corresponding to the three categories of metrics described above: measures of return, risk, and the risk-return tradeoff.

3.1 Comparison of Portfolio Return Measures

Examining the metrics for returns given in Table 1, we make three observations. First, the equal-weighted portfolio significantly outperforms the price- and value-weighted portfolios, with a mean annual return of 13.19%, compared to 10.48% for the value-weighted portfolio and 12.07% for the price-weighted portfolio. That is, the total return of the equal-weighted portfolio is higher than that of the value- and price-weighted portfolios by 271 and 112 basis points per annum, and the p-values for both these differences are 0.0. This is true also net of transactions costs of 50 basis points: the total return of the equal-weighted portfolio is higher than that of the value- and price-weighted portfolios by 238 and 88 basis points per annum, and the p-values for both these differences are 0.0. Compared to the value-weighted portfolios gains, equal-weighted portfolio gains are higher in 67.7% of cases, and, as compared to the price-weighted portfolio gains — in 64.2% of cases during twelve months. Net of transaction costs these numbers decrease only by 1% and 2%.

Second, the differences in the four-factor alphas are even more striking:[5] the annual alpha for the value-weighted portfolio is 60 basis points and for the price-weighted portfolio is 67 basis points, while that for the equal-weighted portfolio is 175 basis points, which is more than 2.5 times greater. The systematic component of return for the equal-weighted portfolio exceeds that of the value-weighted portfolio by 156 basis points per year, while it is similar to that of the price-weighted portfolio. Consequently, of the total excess mean return earned by the equal-

4 - The performance of portfolios constructed from the stocks constituents of S&P400 and S&P600 is reported in Tables A2 and A3. Comparing these two tables with Table 1, one can verify that the main insights for the weighting rules are similar across the three indexes; see Section 6.1 for a discussion of this comparison.
5 - The estimates of the beta coefficients for the four-factor model are given in Table 3.

weighted portfolio over the value- and price-weighted portfolios, the proportions coming from the differences in alphas are 42% and 96%, respectively.

Because of the monthly trading to maintain equal weights, the equal-weighted portfolio has a higher turnover than that of the value- and price-weighted portfolios. The value- and price-weighted portfolios do not require any trading, but they do need to be rebalanced when some stocks enter and others exit the index and when there is a change in the market capitalization or the stock price because of secondary public offerings, stock splits, etc. The turnover of the equal-weighted portfolio is about six times that of the value-weighted portfolio and about three times that of the price-weighted portfolio. Assuming a conservative transaction cost of 50 basis points (in the market today, the transaction cost for non-retail traders is less than 10 basis points), the equal-weighted portfolio incurs transaction costs of about 0.41% per year, while the transactions costs are only 0.07% and 0.16% for the value- and price-weighted portfolios, respectively. Our third observation is that even after adjusting for these transactions costs, the total mean returns and the four-factor alpha are signicantly different for the equal-weighted portfolio and the two other weighting rules.

Among the equal-, value- and price- weighted portfolios, the smallest *distance* lies between the price and equal weights and is equal 0.0671. The distance between the value and price weights is more than double, 0.1733; and, the largest difference is between the value and equal weights, 0.1867. Thus, the equal and price weights are more similar; value weights differ more from equal weights than from the price weights.

3.2 Comparison of Portfolio Risk Measures

Examining the various measures of risk in Table 1, we see that the per annum volatility (standard deviation) is 0.1790 for the equal weighted portfolio, 0.1646 for the price-weighted portfolio, and 0.1583 for the value-weighted portfolio, with the difference in volatility between the equal-weighted portfolio and the other two portfolios being statistically signicant (the p-values for both differences are 0.0). Thus, total-return volatility is highest for the equal-weighted portfolio, lowest for the value-weighted portfolio, with the volatility for the price-weighted portfolio being in the middle. The effect of transaction costs on volatility is very small (the difference shows up only in the fifth decimal point).

Skewness is higher (less negative) for the equal-weighted portfolio compared to the value- and price weighted portfolios. The difference in skewness for the equal- and price-weighted portfolios is statistically significant (p-value of 0.0), but the difference in skewness for the equal- and value-weighted portfolios is not statistically significant (p-value of 0.43). Transactions costs make skewness slightly more negative.

Kurtosis is highest for the returns on the equal-weighted portfolio at 5.53, lowest for the returns on the value-weighted portfolio at 4.84, with the kurtosis for the price-weighted portfolio being in the middle. The difference in kurtosis between the equal-weighted and value-weighted portfolios is statistically significant with a p-value of 0.01. The kurtosis net of transactions costs is not very different from kurtosis before transaction costs.

A useful metric for any portfolio manager is the maximum drawdown. The equal-weighted portfolio has slightly higher portfolio drawdown compared to both value- and price-weighted portfolios, and this difference is statistically significant. The point estimate of the portfolio drawdown is lowest for the value-weighted portfolio, higher for the price-weighted portfolio, and highest for the equal-weighted portfolio. The reason for this is that when a stock in the portfolio has a drop in its price, the price- and value-weighted portfolios react immediately by allocating *less* weight to this stock and more weight to the other assets in the portfolio. The equal-weighted portfolio, on the other hand, on the next rebalancing date allocates *more* wealth to the stock whose price has dropped, which increases the portfolio drawdown in case the stock price continues to decline.

3.3 Comparison of Risk-Return Tradeoff Measures

The observations regarding the risk-return metrics follow directly from our analysis of the return and risk measures above. The main observation is that the equal-weighted portfolio outperforms the price- and value-weighted portfolios in terms of both Sharpe ratio and certainty equivalent return. From Table 1 we see that the annual Sharpe ratio for the equal-weighted portfolio is 0.4275 and for the value-weighted portfolio is 0.3126, with the difference being statistically significant (p-value of 0.0). The price-weighted portfolio has a Sharpe ratio of 0.3966, which is also significantly different from the Sharpe ratio for the equal-weighted portfolio (p-value of 0.05).

For an investor with risk aversion of $\gamma = 2$, the certainty equivalent return for the equal-weighted portfolio is 0.0994, for the value-weighted portfolio is 0.0793, and for the price-weighted portfolio is 0.0930; the differences between the certainty-equivalent returns for the equal-weighted portfolio and the value- and price-weighted portfolios are statistically significant, and the p-values are 0.0 and 0.01, respectively. These results are similar even after transactions costs. However, for an investor with risk aversion of $\gamma = 5$, the certainty-equivalent return for the equal-weighted portfolio exceeds that for the value-weighted portfolio but is less than that for the price-weighted portfolio; and the differences in these certainty-equivalent returns are not statistically significant.

The Sortino and Treynor ratios rank the equal-, value- and the price-weighted portfolio in the same way as the Sharpe ratio and the certainty equivalent: the equal-weighted portfolio has the highest Sortino ratio of 0.6424 and Treynor ratio of 0.0728. These measures are smaller for the price-weighted portfolio and equal to 0.5813 and 0.0662 correspondingly, the smallest for the value-weighted portfolio 0.4534 and 0.0526, correspondingly.

Our goal in the remainder of the paper is to understand the reasons for the difference in the performance of the equal-, price- and value-weighted portfolios. In Section 4, we investigate if there is a relation between a particular stock characteristic and the *total returns* of the equal-, value-, and price-weighted portfolios using the non-parametric monotonicity tests developed in Patton and Timmermann (2010), which is a nested version of the monotonicity test in Romano and Wolf (2011). Then, in Section 5.1, we use the traditional four-factor model to identify the relation between exposures of portfolios to risk factors and the systematic component of total return that is earned by these three portfolios for bearing systematic risk. While the four-factor model is useful for identifying the relation between exposure to risk factors and the systematic component of total return, it leaves the source of alpha unexplained. In Section 5.2, we demonstrate that the rebalancing required to maintain equal weights is the source of the difference between the alpha of the equal-weighted portfolio and that of the value- and price-weighted portfolios.

4. Characteristics Related to Outperformance of Equal-Weighted Portfolios

In this section, we study eight characteristics of stocks that could potentially be driving the differences in total returns of the equal-, value-, and price-weighted portfolios. The eight characteristics we consider are size, book-to-market, 3-month momentum, 12-month momentum, reversal, price, liquidity, and idiosyncratic volatility. The study of size, book-to-market, and price is motivated by the work of Conrad, Cooper, and Kaul (2003). The analysis of momentum and reversal is motivated by the work Jegadeesh (1990) and Jegadeesh and Titman (1993, 2002).

The study of liquidity is motivated by the work of Amihud (2002); for a review of the recent literature on liquidity, see Goyenko, Holden, and Trzcinka (2009). A good discussion of the recent work on idiosyncratic volatility can be found in Fu (2009).

We describe our analysis of characteristics in two parts. First, in Section 4.1, we explain the methodology used to study the relation between each characteristic and the total returns of the equal-, value, and price-weighted portfolios. Then, in Section 4.2, we report the results of our investigation of each of the eight characteristics. To verify that the selected characteristics can explain the cross-sectional differences in expected stock returns, we run the two-stage Fama and MacBeth (1973) regressions; the findings are described in Appendix B.5 and Table A1.

4.1 Analysis of Characteristics: Methodology

We now analyze the relation between various stock characteristics and the returns on the equal-, value-, and price-weighted portfolios using the nonparametric monotonicity tests developed in Patton and Timmermann (2010), which is a nested version of the tests developed by Romano and Wolf (2011). In particular, we test the hypothesis that there is a monotonic relation between a particular characteristic and the difference in returns between (i) the equal- and value-weighted portfolios, and (ii) the equal- and price-weighted portfolios.

The steps entailed in this analysis are the following. For each of the one thousand portfolios of size $N = 1,000$, we sort the stocks at the end of each month by a particular characteristic. We merge the sorted portfolios into a portfolio of N "synthetic assets," where for each asset $j = 1, \ldots, N$ the characteristic is equal to the mean characteristic of all stocks with rank j after the sorting procedure, and the return of the synthetic asset j for the next period is equal to the mean return of all the stocks with the same rank j.[6] Then we compute the relation between the characteristic and the difference in the total portfolio return of the value- and equal-weighted portfolios, relative to the price- and equal-weighted portfolios; we display this relation in Figures 1—8, and in Table 2 report the results for the test that the relation is monotonic.

To test for an increasing (decreasing) relation we form the pairwise differences of the values of the test series (the value of decile i minus the value of decile $i-1$, where $i = 2, \ldots, 10$), bootstrap the differences in the time series dimension,[7] find the minimum (maximum) of each bootstrapped sample, and compute the probability that the minimum (maximum) of the differences is greater (smaller) than the sample minimum (maximum) of the differences.[8]

We also perform a stronger test for a monotonic relation, where we consider not only the pairwise differences of the neighboring data points, but also the differences between all possible pairs. This allows us to improve the test statistic if there is a strong monotonic relation, while it will decrease the power of the test if there are deviations from monotonicity (either a change of the monotonicity direction or less pronounced monotonicity).

4.2 Analysis of Characteristics: Results

It has been shown by Conrad, Cooper, and Kaul (2003) that "size" as a sorting characteristic plays a signicant role in forming sorts-based portfolios. Because the equal-weighted portfolio overweights small size stocks compared to the value-weighted portfolio, it could be at least partly responsible for the equal-weighted portfolio outperforming a value-weighted portfolio. Our results support this. We plot the difference between equal-, and value- and price-weighted portfolio decile returns in Figure 1. This figure shows that size plays a role in explaining the difference in decile returns. Table 2 shows that for the differences in returns between the equal- and value-weighted portfolios, and between the equal- and price-weighted portfolios, the tests

6 - We create these synthetic assets to limit the computational burden. Note that monotonicity relation tests use a bootstrap in the time-series dimension, while we use resampling in the cross-sectional dimension to create 1,000 portfolios, and therefore, if we did not create these synthetic assets, the bootstrap would impose a significant computational burden; see Appendix A for additional details.

7 - We use 10, 000 bootstrap samples with the length of the stationary bootstrap being six months, as recommended for monthly data by Patton and Timmermann (2010).

8 - Romano and Wolf (2011) highlight a weakness of the monotonicity tests proposed by Patton and Timmermann (2010) because the critical values of these tests are based on an additional assumption that if a relation is not strictly monotonically increasing, it must be weakly monotonically decreasing. In light of this, we test for *both* weakly increasing and weakly decreasing relations, and conclude that a particular relation is weakly increasing only if the null of a weakly increasing relation is not rejected *and* the null of a weakly decreasing relation is rejected.

for a monotonically increasing relation with the size characteristic are rejected: the p-values for EW—VW and EW—PW are 0.0 for the test of neighboring pairs and also for the stronger test across all pairs.

Conrad, Cooper, and Kaul (2003) also show that the book-to-market characteristic plays an important role in explaining the returns of sort-based portfolios. From Figure 2, we see that the higher is the book-to-market characteristic of the stocks in the portfolio, the more the equal-weighted portfolio outperforms the value-weighted portfolio. In Table 2, we see that for the book-to-market characteristic, the hypothesis of a monotonically decreasing relation with EW—VW is rejected; the p-values are 0.02 both for the test of neighboring pairs and also for the test of all pairs. However, Figure 2 shows that the book-to-market characteristic plays a weaker role in explaining the difference in the performance of the equal- and price-weighted portfolios, and we see from Table 2 that for the relation between book-to-market and EW—PW, none of the p-values are significant.

Jegadeesh (1990) and Jegadeesh and Titman (1993, 2002) have shown that there is a relation between stock returns and momentum when looking at the extreme deciles. Figure 3 shows that the relation between 3-month momentum and the difference in returns of the equal- and value-weighted and also the equal- and price-weighted portfolios is not monotonic. Table 2 confirms this: none of the p-values are significant for the test of a monotonic relation between 3-month momentum and EW—VW or 3-month momentum and EW—PW.

Figure 4 shows that the relation between 12-month momentum and the difference in returns of the equal- and value-weighted is not monotonic; Table 2 supports this: the p-values for the relation between 12-month momentum and the difference in returns for the equal- and value-weighted portfolios, EW—VW, are not significant. However, the relation between 12-month momentum and the difference in returns of the equal- and price-weighted portfolios is monotonically increasing; Table 2 shows that the null of a monotonically increasing relation of EW—PW with 12-month momentum is rejected: the p-values for both the test of neighboring pairs and the test of all pairs are 0.01.

Figure 5 shows that the relation between the "reversal" characteristic and the performance of the equal-weighted portfolio relative to the value- and price-weighted portfolios is also not monotonic, and Table 2 confirms this: none of the p-values for reversal are significant. However, the equal-weighted portfolio strongly outperforms the other two portfolio rules for the deciles with the lowest and the highest reversal characteristic. In Section 5.2, this observation will guide our investigation into the source of the excess alpha earned by the equal-weighted portfolio relative to the value- and price- weighted portfolios.

From Figure 6, we see that the "price" characteristic has a strongly decreasing relation to the performance of equal-weighted portfolio relative to both the value- and price-weighted portfolios. Table 2 shows that we can reject the null of an increasing relation between the price characteristic and EW—VW and also EW—PW: the p-values are 0.0 for the test of neighboring pairs and also the test of all pairs.

There is a large literature documenting the relation between liquidity and stock returns; see, for example, Amihud (2002) and the review article by Goyenko, Holden, and Trzcinka (2009). From Figure 7 we see that the relation between "liquidity" and the return of the equal-weighted portfolio relative to the value-weighted portfolio shows a strongly decreasing pattern; not surprisingly, in Table 2 the p-values for an increasing relation between the liquidity characteristic and EW—VW are 0.0. Similarly, the figure shows evidence of a monotonically decreasing relation between liquidity and the return on the price-weighted portfolio relative to the equal-weighted portfolio; the p-values in Table 2 for an increasing relation between liquidity and EW—PW are 0.0.

Several papers in the literature have argued that there is a relation between stock returns and idiosyncratic volatility; see Fu (2009) for a discussion of this literature. Figure 8 shows that idiosyncratic volatility has an increasing relation to the differences between the performance of the equal-weighted portfolio relative to the value- and price-weighted portfolios: the higher the idiosyncratic volatility of the assets in the portfolio, the higher is the return on the equal-weighted portfolio compared to that of the value- and price-weighted portfolios. Table 2 confirms this: the p-values for the hypothesis of a monotonically decreasing relation between idiosyncratic volatility and EW—VW and also EW—PW are 0.0 for the test of neighboring pairs and the test of all pairs.

In summary, Figures 1—8 and Table 2 show that the difference in returns of the equal- and value-weighted portfolios has a monotonically decreasing relation with size, price, and liquidity, and a monotonically increasing relation with book-to-market and idiosyncratic volatility. These figures and table also indicate that the difference between the returns of the equal- and price-weighted portfolios has a monotonically decreasing relation with size, 12-month momentum, price and liquidity, and a monotonically increasing relation with idiosyncratic volatility.

5. Explaining Excess Return of Equal-Weighted Portfolios

In the section above, we used a nonparametric approach to identify which characteristics of stocks could be driving differences in the *total return* of the equal-weighted portfolio relative to the value- and price-weighted portfolios. In Section 5.1, we use the standard four-factor model to decompose the total return into *systematic return*, which is compensation for bearing factor risk, and *alpha*. We then identify the difference in exposure to the four factors that are responsible for differences in the systematic returns of the equal-, value-, and price-weighted portfolios. Section 5.2 is devoted to understanding the source of the differences in alpha.

5.1 Explaining Excess Systematic Return of Equal-Weighted Portfolios

In this section, we measure the sensitivity of the returns for the equal-, value-, and price-weighted portfolios to the Fama and French (1993) and momentum (Carhart (1997)) factors. We estimate the beta parameters by regressing monthly portfolio returns on the excess market return, size, value, and momentum factors, and the results of this estimation are reported in Table 3. We see from this table that the R^2 for equal-, value-, and price-weighted portfolios exceed 0.93, which indicates that these four factors explain most of the variation in portfolio returns.

The systematic component of return for the equal-weighted portfolio, reported in Table 1, is 0.1144; it exceeds that of the value-weighted portfolio by 156 basis points per year, while it is similar to that of the price-weighted portfolio.[9] Annualized four-factor alpha (α_4) of the equal-weighted portfolio is 175 basis points and significant, while alphas of the value- and price-weighted portfolios are 60 and 67 basis points.[10]

To determine the source of differences in systematic returns for the equal-, value-, and price-weighted portfolios, we look at differences in exposure to the four risk factors. Exposure to the market ("mkt") factor for the equal-weighted portfolio is 1.0797; however, for the value-weighted portfolio it is 0.9890 and for the price-weighted portfolio it is 1.0311, with the difference relative to the value-weighted portfolio being statistically significant.

The exposure to the size factor ("smb") is positive for the equal-weighted portfolio (0.0955), but it is negative for the value- and price-weighted portfolios (—0.2024 and —0.0249, respectively), with the differences in exposure relative to the equal-weighted portfolio being significant. The beta for the value ("hml") factor for the equal-weighted portfolio is 0.3027, for the price-weighted portfolio it is only 0.1790, and for the value-weighted portfolio it is even smaller, only 0.0234;

9 - Over our sample period, the annualized factor risk premiums are: mkt—rf = 0.0494, where rf = 0.0553; smb = 0.0272; hml = 0.0496; and, umd = 0.0861.
10 - Note, that we discuss the significance of the estimated parameters, but in Table 3 we report p-values of the hypothesis that the exposure to the factors of the equal-weighted portfolio is different from the corresponding exposure of the value- and price-weighted portfolios.

the reason for this difference is because the equal-weighted portfolio loads more on small stocks, compared to the value- and price-weighted portfolios. The exposures to hml of the value- and price-weighted portfolios differ significantly from the exposure of the equal-weighted portfolio, with these differences having p-values of 0.0. The higher exposure of the equal-weighted portfolio to the smb and hml factors supports the conjecture that the equal-weighted portfolio overweights small size and high value stocks.

Finally, all three portfolios have a negative exposure to the momentum factor. The exposure of the equal-weighted portfolio is −0.1379. The exposures for the value- and price-weighted portfolios are smaller in absolute magnitude: −0.0130 and −0.0063, respectively. Again, the differences in these exposures relative to the equal-weighted portfolio are significant.

We also extend the four-factor model by including the reversal factor[11] (constructed by K. French and available on his website). We find that the exposure of the equal-weighted portfolio to the reversal factor equals 0.0292, and it is significant; the exposure of the value-and price-weighted portfolios to the reversal factor is not statistically significant. Moreover, the five-factor alpha of the equal-weighted portfolio is 0.0155, which is 11% smaller than the four-factor alpha estimated earlier. Thus, we see that the systematic reversal factor does not account for the entire alpha, and that there is a significant idiosyncratic component that is earned by the equal-weighted portfolio and that is unexplained by the factor models.

In summary, relative to the value- and price-weighted portfolios, the equal-weighted portfolio has higher (more positive) exposure to the market, size, reversal and value factors, and a more negative exposure to the momentum factor. These differences in exposures explain the differences in the systematic component of returns of the value- and price-weighted portfolios relative to the equal-weighted portfolio.

5.2 Explaining Excess Alpha of Equal-Weighted Portfolios

In Table 3, the four-factor model shows that a substantial part of the differences in return of the equal-, value-, and price-weighted portfolios arise from differences in alpha. Of the total excess mean return earned by the equal-weighted portfolio over the value-weighted portfolio, 42% comes from the difference in alpha and 58% from the excess systematic component. On the other hand, of the total excess mean return earned by the equal-weighted portfolio relative to the price-weighted portfolio, 96% comes from the difference in alpha and only 4% from the difference in systematic return. In this section, we demonstrate that the source of this extra alpha of the equal-weighted portfolio is the "contrarian" rebalancing each month that is required to maintain equal weights, which exploits the "reversal" in stock prices that has been identified in the literature (see, for instance, Jegadeesh (1990) and Jegadeesh and Titman (1993, 2002)).

To demonstrate our claim, we consider two experiments, which are in opposite directions. In the first experiment, we reduce the frequency for rebalancing the equal-weighted portfolio from 1 month, to 6 months and then to 12 months. If our claim is correct, then as we reduce the rebalancing frequency, we should see the alpha of the equal-weighted portfolio decrease toward the level of the alpha of the value- and price-weighted portfolios, which do not entail any rebalancing.

In the second experiment, we reverse the process and artificially fix the weights of the value- and price-weighted portfolios to give them the contrarian flavor of the equal-weighted portfolio. For instance, consider the case where the rebalancing frequency is $t = 12$ months. Then each month we change the weights of the value- and price-weighted portfolios so that they are the same as the initial weights at $t = 0$. Only after 12 months have elapsed, do we set the weights to be the true value and price weights. Then, again for the next 12 months, we keep the weights of the value- and price-weighted portfolios constant so that they are equal to the weights for these portfolios

11 - Over our sample period, the annualized reversal risk premium equals 0.064, the standard deviation and the correlation of the reversal factor with the the other four factors is similar to the standard deviation and correlation between market, size, value and momentum factors.

at the 12-month date. Only after another 12 months have elapsed do we set the weights to be the true value and price-weighted weights at t = 24 months. We undertake this experiment for rebalancing frequencies of 6 and 12 months. If our claim is correct, then as we keep fixed the weights of the value- and price-weighted portfolios for 6 months and 12 months, the alphas of these two portfolios should *increase* toward the alpha of the equal-weighted portfolio.

The results of both experiments confirm our hypothesis that it is the monthly rebalancing of the equal-weighted portfolio that generates the alpha for this strategy. Table 4 shows that as we reduce the rebalancing frequency of the equal-weighted portfolio from the base case of 1 month to 6 months and then to 12 months, the per annum alpha of the equal-weighted portfolio drops from 175 basis points to 117 basis points and then to 80 basis points. Once the rebalancing frequency of the equal-weighted portfolio is 12 months, the difference in the alpha of the equal-weighted portfolio and that of the value- and price-weighted portfolios is no longer statistically significant (the p-value for the difference in alpha of the equal- and value-weighted portfolios is 0.96 and for the difference of the equal- and price-weighted portfolios is 0.98).

Similarly, for the second experiment we see from Table 5 that once we hold constant the weights of the value- and price-weighted portfolios for 12 months and rebalance the weights only after 12 months, the differences in alphas for the equal-weighted portfolio relative to the value- and price-weighted portfolios is statistically insignificant (with the p-values being 0.65 and 0.30).

An important insight from these experiments is that the higher alpha of the equal-weighted portfolio arises, not from the choice of equal weights, but from the monthly rebalancing to maintain equal weights, which is implicitly a contrarian strategy that exploits reversal that is present at the monthly frequency. Thus, alpha depends on only the rebalancing strategy and not on the choice of initial weights.

6. Robustness Tests

In this section, we briefly discuss some of the experiments we have undertaken to verify the robustness of our findings.

6.1 Different Stock Indexes

In addition to stocks sampled from the S&P500 for large-cap stocks, we consider also stocks from the S&P400 for mid-cap, and the S&P600 for small-cap stocks. The performance of portfolios constructed from the stocks constituents of S&P400 and S&P600 is reported in Tables A2 and A3. Comparing the performance metrics in these tables to those for the stocks constituents of S&P500, we see that the main insights for the weighting rules are similar across the three indexes.

6.2 Different Number of Stocks

The results that we have reported are for portfolios with N = 100 stocks. In addition to considering portfolios with 100 stocks, we also consider portfolios with 30, 50, 200, and 300 stocks (again, with resampling over 1,000 portfolios). We find that our results are not sensitive to the number of assets in the portfolio. These results are available from the authors.

6.3 Different Economic Conditions

We also investigate whether the superior performance of the equal-weighted portfolio relative to the value- and price-weighted portfolios is sensitive to the date on which one invests in the portfolio. In particular, we examine whether the relative performance of these portfolios is different if one starts at the peak or trough of the business cycle.

The NBER identifies peaks of the business cycle in March 2001 and December 2007, and a trough in November 2001. In Table 6, we report the performance of the equal-, value-, and price-weighted portfolios starting at these three dates and that are held to the end of our data period, December 2009. For all three starting dates, we find that the equal-weighted portfolio has a significantly higher total mean return. For all three starting dates, the one-factor and four-factor alphas are significantly higher for the equal-weighted portfolio relative to the value-weighted portfolios. In fact, the four-factor alpha for the equal-weighted portfolio is positive for all three starting dates, while it is negative for the value-weighted portfolio for the start dates of March 2001 and December 2007. The Sharpe ratio of the equal-weighted portfolio also exceeds that of the value- and price-weighted portfolios. For instance, if one had initiated the portfolios at the peak of March 2001, the Sharpe ratio of the equal-weighted portfolio would have been 0.2639 compared to only 0.0037 for the value-weighted portfolio; if one had started at the trough of November 2001, the Sharpe ratio of the equal-weighted portfolio would have been 0.3615 rather than the 0.1252 for the value-weighted portfolio; and, if one had started at the peak of December 2007, the Sharpe ratio of the equal-weighted portfolio would have been –0.0795 while that of the value-weighted portfolio was –0.3780, and that for the price-weighted portfolio was –0.2995. The certainty equivalent return for an investor with a risk aversion of $\gamma = 2$ is also higher for the equal-weighted portfolio relative to the value- and price-weighted portfolios. For a risk aversion of $\gamma = 5$, the equal-weighted portfolio outperforms the value-weighted portfolio but not the price-weighted portfolio; however, in both cases the difference is not statistically significant.

6.4 Simulated Data

We also evaluate the equal-, value-, and price-weighted portfolios using simulated data that does not suffer from the potential biases and noise in empirical data. Using this simulated data, we analyze the dynamics of 1,000. 000 different portfolios in time, assuming that for each stock in the portfolio, each month, the returns are distributed iid normal with a mean of 6% per anum and a volatility of 30% per anum. We find that with a one-month rebalancing frequency the equal-weighted portfolio outperforms the value- and price-weighted portfolios in a majority of cases. Moreover, we find that decreasing the rebalancing frequency of the equal-weighted portfolio from 1 to 6 and then to 12 months negatively affects its performance in terms of both total return and one-factor alpha.

7. Conclusion

We compare the performance of the equal-weighted portfolio to that of the price- and value-weighted portfolios. We find that the equal-weighted portfolio outperforms the price- and value-weighted portfolios in terms average return, four-factor alpha, Sharpe ratio, and certainty-equivalent return, even though the return of the equal-weighted portfolio has higher volatility, kurtosis and turnover. Even after allowing for a transaction cost of 50 basis points, the equal-weighted portfolio has a significantly higher mean return and four-factor alpha than the value- and price-weighted portfolios.

To understand the reasons for this difference in performance, we select N stocks from a particular index and construct the equal-, value-, and price-weighted portfolios. For robustness, we consider several different values for the number of stocks in the portfolio: $N = \{30, 50, 100, 200, 300\}$. And, again for robustness, we choose stocks from three U.S. stock indices—the S&P500 for large-cap stocks, the S&P400 for mid-cap stocks, and the S&P600 for small-cap stocks. Finally, to ensure that our performance metrics are not based on just one sample of stocks, we form 1,000 randomly chosen portfolios of a given size, and compute all performance metrics for each portfolio-weighting rule by averaging across these 1,000 portfolios.

We first use the nonparametric test of Patton and Timmermann (2010) to investigate the presence of a monotonic relation between stock characteristics and the total return of the equal-weighted portfolio, relative to the total return of value- and price-weighted portfolios. We find that the return of the equal-weighted portfolio, in excess of the value- and price-weighted portfolios, is monotonically decreasing with size, price and liquidity, and monotonically increasing with idiosyncratic volatility. Book-to-market is monotonically related to the difference in returns of only the equal- and value-weighted portfolios, while 12-month momentum is related to the difference in returns of only the equal- and price-weighted portfolios.

Motivated by the findings from the non-parametric tests that indicate a monotonic relation between the excess returns earned by the equal-weighted portfolios relative to the value- and price-weighted portfolios and stock characteristics such as idiosyncratic volatility, we then use the standard four-factor model to decompose the total return into a systematic component and alpha. We find that the higher *systematic return* of the equal-weighted portfolio relative to the value- and price-weighted portfolios arises from its relatively higher exposure to the market, size and value factors. The higher *alpha* of the equal-weighted portfolio arises from the monthly rebalancing that is required to maintain equal weights, which is a contrarian strategy that exploits the time-series and cross-sectional properties of stock returns (see, for example, Campbell, Lo, and MacKinlay (1997, pp. 77—79)); thus, alpha depends only on the rebalancing strategy and *not* on the particular choice of initial weights.

Therefore, the answer to the question posed in the title of this manuscript is that the equal-weighted portfolio outperforms the value- and price-weighted portfolios partly because of its higher exposure to the market, size, and value risk factors, and partly because of the higher alpha of the equal-weighted portfolio, whose source is the portfolio's monthly rebalancing that takes advantage of reversal, idiosyncratic volatility, and the lead-lag characteristics of stock returns at the monthly frequency.

A. Data

From February 1967 to the end of 2009 there were 1449 stocks that were part of the S&P500 index. Our time series consists of 515 months, which corresponds to 43 years. From the set of 1,449 stocks we randomly choose a sample of stocks that are constituents of the index at the time they are selected.

We work with these samples and construct portfolios of different stock numbers: $N = \{30, 50, 100, 200, 300\}$ stocks. In order to reduce the selection bias, for each portfolio with N stocks, we randomly resample to select N stocks 1,000 times and construct 1,000 portfolios. To compute the portfolio performance metrics, we compute the performance metrics for each of the 1,000 portfolios and report the performance metrics averaged across these 1,000 portfolios.

In Section 4, we study the characteristics of assets that could possibly drive the differences in the performance of the equal-, value- and price-based weighting rules. To perform the monotonicity test described in Section 4.1 for each resampled set of assets for each portfolio would be very demanding in terms of computer power and time. Therefore, for studying the portfolio of N stocks, we draw 1,000 times N assets from the population of stocks, and form 1,000 resampled portfolios of the size N. For each resampled portfolio every month, we sort the assets with respect to a particular characteristic (size, book-to-market, momentum, reversal, price, liquidity, idiosyncratic volatility) and construct a "synthetic" asset, which is the average asset over the 1,000 samples. We assign to each asset of rank $j = 1,\ldots,N$ the mean return and mean characteristic over the randomly chosen 1,000 assets with the same rank j.

We then analyze the performance of the portfolio deciles constructed from the synthetic assets. Each decile's characteristic is the time series mean of an average value of the characteristic of the assets in this decile. Annualized returns of each decile expressed in percentage are computed as the time series mean of the returns of the portfolios constructed from the assets of that decile, with three different weighting rules (equal-, value- and price-weighted), for each decile. "Decile weight" (annualized in %) is then the time series average of the sum of the weights of the assets of the decile in the whole portfolio. To compute the time series average contribution of the decile to the portfolio return (annualized in %), we first multiply the returns of the assets in the decile by their weight in the overall portfolio, sum this, and divide it by the return of the whole portfolio. We then take the time series mean and compute the percentage contribution of each decile to the portfolio return.

B. Stock Characteristics

This section explains how we use CRSP and COMPUSTAT data to construct the various characteristics used in our analysis.

B.1 Size, Book, Book-to-Market

To compute the size characteristic of the stock we multiply the stock's price (as given in CRSP) by the number of the shares outstanding (variable name in COMPUSTAT database: CSHOQ Common Shares Outstanding). To compute the book characteristic we take current assets (ACTQ Current Assets Total), subtract current liabilities (LCTQ Current Liabilities Total), subtract preferred/preference stock redeemable (PSTKRQ Preferred/Preference Stock Redeemable), and add deferred taxes and investment tax credit (TXDITCQ Deferred Taxes and Investment Tax Credit). The book-to-market characteristic is a ratio of the computed book characteristic and the market characteristic.

B.2 Momentum and Reversal

To compute 3- and 12-month momentum, we aggregate the returns over the past 3 months (months $t-4$ to $t-2$) and past 12 months (months $t-13$ to $t-2$). The stock's reversal characteristic is the return on the stock in the previous month.

B.3 Price and Liquidity

The price characteristic we consider is that given in CRSP. We compute the Amivest liquidity characteristic (Goyenko, Holden, and Trzcinka (2009)) as the previous month (22 working days) average of the ratio of the stock's dollar volume to the absolute value of the return.

B.4 Idiosyncratic Volatility

The typical ARCH model of Engle (1982) gives a volatility prediction at the sampling frequency of the input data. Hence, when the model is fitted to daily returns, it is not a very suitable for longer horizon forecasts that we need for a typical passive investor. For this purpose, some recent papers (e.g., Fu (2009)) suggests using the EGARCH model of Nelson (1991) fitted to monthly excess returns, but in our experiments the estimation did not lead to very stable results. To increase the stability of the estimation and the amount of data available for it, we utilize the MIDAS (Ghysels, Santa-Clara, and Valkanov (2005)) approach. It separates the volatilities into short-run and long-run components, and the latter can be used to predict the second moments at a slower frequency than the data.

For the predicted value of idiosyncratic volatility we use the long-term volatility component from the asymmetric GARCH-MIDAS model (for a detailed discussion of MIDAS models for volatility modeling see, for example, Ghysels, Santa-Clara, and Valkanov (2005); Engle, Ghysels, and Sohn (2008)) that we fit to the residual from regressing the daily stock return on the Fama and French (1993) factors.

Specically, excess volatilities follow the ASYGARCH-MIDAS process as follows:

$$r_{k,t} = \alpha_{k,t} + \beta_{k,t}^{MKT} \times F_t^{M} + \beta_{k,t}^{SMB} \times F_t^{SMB} + \beta_{k,t}^{HML} \times F_t^{HML} + \varepsilon_{k,t} \quad \text{(B1)}$$

$$\varepsilon_{k,t} = \sqrt{m_{k,t} \times g_{k,t}}\xi_{k,t} \quad \text{(B2)}$$

$$g_{k,t} = (1 - \alpha_k - \kappa_k) + \alpha_k \frac{\varepsilon_{k,t}^2}{m_{k,t}} + \kappa_k \cdot g_{k,t-1} \quad \text{(B3)}$$

$$m_{k,t} = \overline{m}_k + \theta_k^{+} \sum_{l=1}^{Lv} \varphi(\omega_{k,v}^{+}) \times RV_{k,t-l}^{+} + \theta_k^{-} \sum_{l=1}^{Lv} \varphi(\omega_{k,v}^{-}) \times RV_{k,t-l}^{-} \quad \text{(B4)}$$

$$RV_{k,t}^{+} = \frac{1}{N^{+}} \sum_{\tau=0}^{20} \left(r_{k,t-\tau} * 1_{r_{k,t-\tau}>0}\right)^2, \quad RV_{k,t}^{-} = \frac{1}{N^{-}} \sum_{\tau=0}^{20} \left(r_{k,t-\tau} * 1_{r_{k,t-\tau}<0}\right)^2, \quad \text{(B5)}$$

where $r_{k,t}$ is the (daily) return of asset k = 1, 2,..., N, F_t^J is factor $J \in$ {MKT, SMB, HML}, the short-run idiosyncratic volatility component $g_{k,t}$ follows a unit GARCH process, and the long-run idiosyncratic volatility component $m_{k,t}$ is the weighted sum of positive $(RV_{k,t}^{+})$ and negative $(RV_{k,t}^{-})$ mean-squared-return innovations (where N^{+} and N^{-} are the number of positive and negative return innovations, respectively). To aggregate the past RVs, we use the Beta polynomial weighting functions $\gamma(\omega^{+})$, and $\gamma(\omega^{-})$ with Lv = 126 lags.

We fit the above model for each underlying stock at the end of each month, using three years of daily returns. We use maximum likelihood to simultaneously find factor sensitivities $(\beta_{k,t}^{J})$, the parameters of the short-run volatility α_k and κ_k, the parameters of the long-run volatility $\overline{m}_k$, θ_k^{+}, θ_k^{-}, and the optimal weights for the Beta weighting function ω^{+} and ω^{-}. After estimating these parameters, we compute the predicted value of long-run idiosyncratic volatility $m_{k,t}$ and use that as the characteristic for idiosyncratic volatility.

B.5 Fama and MacBeth (1973) Regressions Results

Before we start analyzing the effect of each characteristic on the returns of equal-, value-, and price-weighted *portfolios*, we need to establish that the characteristics we are considering can actually explain the cross-sectional differences in expected *stock* returns for our sample of stocks and over the time period of our study. We do this using two-stage Fama and MacBeth (1973) regressions, where in the first stage we regress the stock returns for every month on each of the characteristics and collect the time series of the coefficients (betas), and in the second stage, we compute the time series average of the betas and test their significance. We run Fama and MacBeth (1973) univariate regressions for each characteristic individually and for all characteristics jointly, but, in order to avoid problems arising from collinearity, in the multivariate tests we exclude the 3-month momentum characteristic in the first joint test, exclude the 12-month momentum characteristic in the second joint test, and exclude both the 3- and 12-month momentum characteristics in the third joint test.

The results for the univariate (Column 2) and multivariate (Columns 3, 4, and 5) regressions are given in Table A1. Size is significant in only the univariate regression. Book-to-market is significant in the univariate and multivariate regressions. 3-month momentum has a negative beta that is significant in only the univariate regression; 12-month momentum is not significant in any of the regressions. Reversal is significant in the univariate and multivariate regressions. Price has a negative beta and has a p-value of 0.03 in the univariate regression and a p-value of about 0.10 in the multivariate regressions. Liquidity has a negative beta; it has a p-value of 0.02 in the univariate regression and a p-value of about 0.10 in the multivariate regressions. Idiosyncratic volatility has a positive beta in the univariate regression and a negative beta in the multivariate regressions, but neither is significant.[12]

12 - The difference in results for the univariate and multivariate regressions can arise because of an omitted variables bias.

Table 1: Performance of Equal-, Value-, and Price-Weighted Portfolios

In this table we report the performance metrics for portfolios constructed from the constituents of the S&P500 index. All metrics are calculated using monthly returns from February 1967 to December 2009 (515 months). The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, four-factor alpha, turnover, transaction costs, distance to equal weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance, before transactions costs, and net of transactions costs of 50 basis points, for portfolios formed using different weighting rules: EW denotes the equal-weighted portfolio, VW the value-weighted portfolio, and PW the price-weighted portfolio.

Metrics (per year)	Performance before transaction costs			Performance net of transaction costs		
	EW	VW	PW	EW	VW	PW
Total Return	0.1319	0.1048	0.1207	0.1279	0.1041	0.1191
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Systematic Return	0.1144	0.0988	0.1140	0.1144	0.0988	0.1140
	(1.00)	(0.00)	(0.40)	(1.00)	(0.00)	(0.40)
Outperformance frequency	0.0000	0.6770	0.6418	0.0000	0.6674	0.6268
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
One-factor alpha	0.0246	0.0028	0.0165	0.0205	0.0021	0.0150
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.02)
Four-factor alpha	0.0175	0.0060	0.0067	0.0135	0.0053	0.0052
	(1.00)	(0.02)	(0.00)	(1.00)	(0.08)	(0.00)
Turnover	0.8132	0.1431	0.3135	0.8132	0.1431	0.3135
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Transaction costs	0.0041	0.0007	0.0016	0.0041	0.0007	0.0016
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Distance to value weights	0.1867	0.0000	0.1733	0.1867	0.0000	0.1733
	(1.00)	(0.00)	(0.01)	(1.00)	(0.00)	(0.01)
Distance to price weights	0.0671	0.1733	0.0000	0.0671	0.1733	0.0000
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Volatility	0.1790	0.1583	0.1646	0.1790	0.1583	0.1646
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Skewness	-0.3266	-0.3860	-0.4996	-0.3266	-0.3860	-0.4996
	(1.00)	(0.21)	(0.00)	(1.00)	(0.21)	(0.00)
Kurtosis	5.5305	4.8372	5.3608	5.5305	4.8372	5.3608
	(1.00)	(0.00)	(0.19)	(1.00)	(0.00)	(0.19)
Max Drawdown	0.1152	0.1043	0.1075	0.1163	0.1045	0.1079
	(1.00)	(0.02)	(0.00)	(1.00)	(0.01)	(0.00)
Sharpe Ratio	0.4275	0.3126	0.3966	0.4048	0.3081	0.3871
	(1.00)	(0.00)	(0.03)	(1.00)	(0.00)	(0.13)
Sortino Ratio	0.6424	0.4534	0.5813	0.6054	0.4465	0.5663
	(1.00)	(0.00)	(0.01)	(1.00)	(0.00)	(0.06)
Treynor Ratio	0.0728	0.0526	0.0662	0.0690	0.0518	0.0646
	(1.00)	(0.00)	(0.01)	(1.00)	(0.00)	(0.05)
CEQ, $\gamma = 2$	0.0994	0.0793	0.0930	0.0953	0.0786	0.0914
	(1.00)	(0.00)	(0.01)	(1.00)	(0.00)	(0.07)
CEQ, $\gamma = 5$	0.0468	0.0389	0.0482	0.0427	0.0382	0.0466
	(1.00)	(0.13)	(0.33)	(1.00)	(0.23)	(0.10)

Table 2: Tests of Monotonicity Relations

In this table we report the p-values of the Patton and Timmermann (2010) test for a monotonic relation between a particular characteristic listed in the first column, and the difference in performance of the equal- and valueweighted portfolios (EW—VW), and the equal- and price-weighted portfolios (EW—PW). We report the p-values of the null hypothesis that difference in returns is increasing with respect to a given characteristics (first row) and also that the difference in returns is decreasing with respect to that characteristic (second row). We undertake two tests: in the first we consider only the differences of neighboring pairs of data points; in the second stronger test, we consider also the differences between all possible pairs. The analysis is based on monthly returns from February 1967 to December 2009.

Characteristic	EW−VW		EW−PW	
Null hypothesis	Neighboring pairs	All pairs	Neighboring pairs	All pairs
Size				
Monotonically increasing relation	0.00	0.00	0.00	0.00
Monotonically decreasing relation	1.00	1.00	1.00	1.00
Book to market				
Monotonically increasing relation	1.00	1.00	1.00	1.00
Monotonically decreasing relation	0.02	0.02	0.34	0.32
Momentum: 3 month				
Monotonically increasing relation	0.94	0.98	0.74	0.69
Monotonically decreasing relation	0.99	1.00	1.00	1.00
Momentum: 12 month				
Monotonically increasing relation	0.96	0.92	0.01	0.01
Monotonically decreasing relation	0.99	1.00	1.00	1.00
Reversal				
Monotonically increasing relation	0.98	1.00	0.94	0.98
Monotonically decreasing relation	0.96	0.99	0.96	0.94
Price				
Monotonically increasing relation	0.00	0.00	0.00	0.00
Monotonically decreasing relation	1.00	1.00	1.00	1.00
Liquidity				
Monotonically increasing relation	0.00	0.00	0.00	0.00
Monotonically decreasing relation	1.00	1.00	1.00	1.00
Idiosyncratic volatility				
Monotonically increasing relation	1.00	1.00	1.00	1.00
Monotonically decreasing relation	0.00	0.00	0.00	0.00

Table 3: Estimation of the Four-Factor Model

In this table we report the results of estimating the 4-factor model with the three Fama and French (1993) factors and the Carhart (1997) momentum factor. We regress monthly returns of equal-, value-, and priceweighted portfolios on the constant, market excess return (*mkt*), small-minus-big (*smb*), high-minus-low(*hml*) and momentum (*umd*) factor returns. We report annualized four-factor alpha (α_4), betas corresponding to each factor along with p-value for the hypothesis that the coefficient is the same for the equal-weight portfolio and the value- and price-weight portfolios, R^2, and MSE (mean squared error) of the regressions. The analysis is based on monthly returns from February 1967 to December 2009. Over our sample period, the annualized factor means for the premia are: mkt—rf = 0.0494, with rf = 0.0553, smb = 0.0272, hml = 0.0496, and, umd = 0.0861.

Portfolio	α_4	β_{mkt}	β_{smb}	β_{hml}	β_{umd}	R^2	MSE
EW	0.0175	1.0797	0.0955	0.3027	-0.1379	0.9361	0.0002
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)	–	–
VW	0.0060	0.9890	-0.2024	0.0234	-0.0130	0.9330	0.0001
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	–	–
PW	0.0067	1.0311	-0.0249	0.1790	-0.0063	0.9351	0.0001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	–	–

Table 4: Alpha As Rebalancing Frequency of Equal-Weighted Portfolio is Decreased

In this table we report the performance metrics for portfolios constructed from the constituents of the S&P500 index. In the base case, the equal-weighted portfolio is rebalanced on a monthly frequency; in the other two cases considered, the equal-weighted portfolio is rebalanced every 6 and every 12 months. The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, four-factor alpha, turnover, transaction costs, distance to value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance of the equal-weighted (EW) portfolio, the value-weighted (VW) portfolio, and the price-weighted (PW) portfolio.

Metrics (per year)	Rebalancing frequency				
	Base case: 1 month			6 month	12 month
	EW	VW	PW	EW	EW
Total Return	0.1319	0.1048	0.1206	0.1285	0.1306
	(1.00)	(0.00)	(0.00)	(0.00)	(0.21)
Systematic Return	0.1144	0.0988	0.1140	0.1168	0.1227
	(1.00)	(0.00)	(0.40)	(0.00)	(0.00)
Outperformance frequency	0.0000	0.6770	0.6419	0.6971	0.6143
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
One-factor alpha	0.0246	0.0028	0.0164	0.0219	0.0249
	(1.00)	(0.00)	(0.00)	(0.00)	(0.45)
Four-factor alpha	0.0175	0.0060	0.0066	0.0117	0.0080
	(1.00)	(0.02)	(0.00)	(0.00)	(0.00)
Turnover	0.8132	0.1431	0.3182	0.3810	0.2664
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
Transaction costs	0.0041	0.0007	0.0016	0.0019	0.0013
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance to value weights	0.1867	0.0000	0.1737	0.1861	0.0664
	(1.00)	(0.00)	(0.01)	(0.00)	(0.23)
Distance to price weights	0.0675	0.1737	0.0000	0.0664	0.0663
	(1.00)	(0.00)	(0.00)	(0.00)	(0.01)
Volatility	0.1790	0.1583	0.1646	0.1761	0.1726
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
Skewness	-0.3266	-0.3860	-0.4990	-0.3636	-0.4868
	(1.00)	(0.21)	(0.00)	(0.02)	(0.00)
Kurtosis	5.5305	4.8372	5.3583	5.5370	5.7857
	(1.00)	(0.00)	(0.19)	(0.45)	(0.02)
Max Drawdown	0.1152	0.1043	0.1075	0.1136	0.1107
	(1.00)	(0.02)	(0.00)	(0.00)	(0.00)
Sharpe Ratio	0.4275	0.3126	0.3958	0.4148	0.4355
	(1.00)	(0.00)	(0.02)	(0.01)	(0.21)
Sortino Ratio	0.6424	0.4534	0.5801	0.6201	0.6457
	(1.00)	(0.00)	(0.01)	(0.00)	(0.43)
Treynor Ratio	0.0728	0.0526	0.0661	0.0706	0.0738
	(1.00)	(0.00)	(0.01)	(0.01)	(0.28)
CEQ, $\gamma = 2$	0.0994	0.0793	0.0929	0.0969	0.1001
	(1.00)	(0.00)	(0.01)	(0.00)	(0.35)
CEQ, $\gamma = 5$	0.0468	0.0389	0.0480	0.0458	0.0501
	(1.00)	(0.13)	(0.34)	(0.15)	(0.03)

Table 5: Alpha When Weights of Value- and Price-Weighted Portfolios Held Constant For Increasing Periods

In this table we report the performance metrics for portfolios constructed from the constituents of the S&P500 index. In the base case, the weights of the value- and price-weighted portfolio are fixed for a month, and are revised at the end of the month. In the other two cases considered, the weights of the of the value- and price-weighted portfolios are reset each month so that they are the same as the initial weights at $t = 0$. Only after 6 months (12 months) have elapsed, do we set the weights to be the true value- and price-weighted weights. Then, again for the next 6 months (12 months), we reset the weights of the value- and price-weighted portfolios each months so that they are equal to the weights for these portfolios at the 6-month (12-month) date. Only after another 6 months (12 months) have elapsed do we set the weights to be the true value and price-weighted weights at $t = 6$ ($t = 12$) months. All metrics are calculated using monthly returns from February 1967 to December 2009. The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, fourfactor alpha, turnover, transaction costs, distance to value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance of the equal-weighted (EW) portfolio, the value-weighted (VW) portfolio, and the price-weighted (PW) portfolio.

Metrics (per year)	Weights fixed for						
	Base case: 1 month			6 month		12 month	
	EW	VW	PW	VW	PW	VW	PW
Total Return	0.1319	0.1048	0.1207	0.1079	0.1251	0.1082	0.1255
	(1.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Systematic Return	0.1144	0.0988	0.1140	0.0954	0.1112	0.0934	0.1088
	(1.00)	(0.00)	(0.80)	(0.00)	(0.02)	(0.00)	(0.00)
Outperformance frequency	0.0000	0.6770	0.6418	0.6692	0.6198	0.6682	0.6174
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
One-factor alpha	0.0246	0.0028	0.0165	0.0056	0.0203	0.0057	0.0201
	(1.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.00)	(0.10)
Four-factor alpha	0.0175	0.0060	0.0067	0.0125	0.0139	0.0148	0.0166
	(1.00)	(0.04)	(0.00)	(0.39)	(0.26)	(0.65)	(0.75)
Turnover	0.8132	0.1431	0.3135	0.7707	0.9488	0.7624	0.9192
	(1.00)	(0.00)	(0.00)	(0.23)	(0.00)	(0.14)	(0.00)
Transaction costs	0.0041	0.0007	0.0016	0.0039	0.0047	0.0038	0.0046
	(1.00)	(0.00)	(0.00)	(0.23)	(0.00)	(0.14)	(0.00)
Distance to value weights	0.1867	0.0000	0.1733	0.0174	0.1738	0.0272	0.1732
	(1.00)	(0.00)	(0.02)	(0.00)	(0.03)	(0.00)	(0.02)
Distance to price weights	0.0671	0.1733	0.0000	0.1747	0.0167	0.1765	0.0265
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Volatility	0.1790	0.1583	0.1646	0.1598	0.1669	0.1610	0.1688
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Skewness	-0.3266	-0.3860	-0.4996	-0.3687	-0.4763	-0.3397	-0.4413
	(1.00)	(0.43)	(0.00)	(0.58)	(0.00)	(0.83)	(0.00)
Kurtosis	5.5305	4.8372	5.3608	4.8464	5.3553	4.7626	5.2243
	(1.00)	(0.01)	(0.39)	(0.01)	(0.36)	(0.01)	(0.09)
Max Drawdown	0.1152	0.1043	0.1075	0.1042	0.1079	0.1046	0.1091
	(1.00)	(0.03)	(0.00)	(0.03)	(0.00)	(0.04)	(0.00)
Sharpe Ratio	0.4275	0.3126	0.3966	0.3292	0.4174	0.3286	0.4150
	(1.00)	(0.00)	(0.05)	(0.00)	(0.55)	(0.01)	(0.45)
Sortino Ratio	0.6424	0.4534	0.5813	0.4803	0.6155	0.4808	0.6138
	(1.00)	(0.00)	(0.02)	(0.00)	(0.33)	(0.01)	(0.28)
Treynor Ratio	0.0728	0.0526	0.0662	0.0555	0.0698	0.0556	0.0693
	(1.00)	(0.00)	(0.01)	(0.00)	(0.31)	(0.01)	(0.20)
CEQ, $\gamma = 2$	0.0994	0.0793	0.0930	0.0820	0.0966	0.0819	0.0964
	(1.00)	(0.00)	(0.01)	(0.00)	(0.35)	(0.00)	(0.27)
CEQ, $\gamma = 5$	0.0468	0.0389	0.0482	0.0408	0.0506	0.0403	0.0496
	(1.00)	(0.27)	(0.66)	(0.39)	(0.21)	(0.35)	(0.39)

Table 6: Portfolio Performance for Different Start Dates Over the Business Cycle

In this table we report the performance metrics for portfolios constructed from the constituents of the S&P500 index. All metrics are calculated using monthly returns with different starting dates but all ending at December 2009. The three starting dates considered are: the peak of the business cycle in March 2001; the trough of November 2001; and, the peak of the business cycle in December 2007. The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, four-factor alpha, turnover, transaction costs, distance to value weights, distance to price weights volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance, before transactions costs and net of transactions costs of 50 basis points for portfolios formed using different weighting rules: EW denotes the equal-weighted portfolio, VW the value-weighted portfolio, and PW the price-weighted portfolio.

Metrics (per year)	Start of the investment period								
	Peak of March 2001			Trough of November 2001			Peak of December 2007		
	EW	VW	PW	EW	VW	PW	EW	VW	PW
Total Return	0.0754	0.0236	0.0566	0.0931	0.0417	0.0746	-0.0143	-0.0788	-0.0674
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Systematic Return	0.0318	0.0288	0.0304	0.0419	0.0366	0.0354	-0.0747	0.0178	-0.0291
	(1.00)	(0.22)	(0.24)	(1.00)	(0.15)	(0.02)	(1.00)	(0.00)	(0.01)
Outperformance frequency	0.0000	0.7380	0.6069	0.0000	0.7246	0.5928	0.0000	0.5665	0.6312
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
One-factor alpha	0.0202	-0.0316	0.0015	0.0372	-0.0136	0.0195	-0.0422	-0.1074	-0.0968
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)	(1.00)	(0.01)	(0.00)
Four-factor alpha	0.0436	-0.0052	0.0262	0.0512	0.0052	0.0392	0.0604	-0.0965	-0.0382
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.05)	(1.00)	(0.00)	(0.00)
Turnover	0.8577	0.1507	0.2474	0.8356	0.1487	0.2429	1.0596	0.1624	0.2234
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Transaction costs	0.0043	0.0008	0.0012	0.0042	0.0007	0.0012	0.0053	0.0008	0.0011
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Distance to value weights	0.1726	0.0000	0.1730	0.1713	0.0000	0.1723	0.1688	0.0000	0.1718
	(1.00)	(0.00)	(0.48)	(1.00)	(0.00)	(0.44)	(1.00)	(0.00)	(0.48)
Distance to price weights	0.0629	0.1730	0.0000	0.0640	0.1723	0.0000	0.0869	0.1718	0.0000
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Volatility	0.1977	0.1619	0.1675	0.1967	0.1598	0.1661	0.2985	0.2322	0.2558
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Skewness	-0.4788	-0.6941	-0.9326	-0.4943	-0.8028	-1.0137	-0.2545	-0.5324	-0.6001
	(1.00)	(0.07)	(0.00)	(1.00)	(0.03)	(0.00)	(1.00)	(0.03)	(0.00)
Kurtosis	4.9714	4.2763	5.4341	5.2173	4.6696	5.8636	3.1466	2.7510	3.2251
	(1.00)	(0.09)	(0.15)	(1.00)	(0.15)	(0.11)	(1.00)	(0.10)	(0.40)
Max Drawdown	0.1445	0.1301	0.1284	0.1391	0.1242	0.1243	0.2631	0.2365	0.2502
	(1.00)	(0.08)	(0.00)	(1.00)	(0.06)	(0.00)	(1.00)	(0.13)	(0.10)
Sharpe Ratio	0.2639	0.0037	0.1993	0.3615	0.1252	0.3163	-0.0795	-0.3780	-0.2995
	(1.00)	(0.00)	(0.03)	(1.00)	(0.00)	(0.09)	(1.00)	(0.00)	(0.00)
Sortino Ratio	0.3741	0.0062	0.2676	0.5223	0.1684	0.4311	-0.1070	-0.4658	-0.3752
	(1.00)	(0.00)	(0.02)	(1.00)	(0.00)	(0.04)	(1.00)	(0.00)	(0.00)
Treynor Ratio	0.0455	0.0006	0.0342	0.0610	0.0212	0.0531	-0.0200	-0.0953	-0.0748
	(1.00)	(0.00)	(0.03)	(1.00)	(0.00)	(0.08)	(1.00)	(0.00)	(0.00)
CEQ, $\gamma = 2$	0.0353	-0.0035	0.0274	0.0535	0.0153	0.0457	-0.1033	-0.1336	-0.1343
	(1.00)	(0.00)	(0.09)	(1.00)	(0.00)	(0.09)	(1.00)	(0.14)	(0.02)
CEQ, $\gamma = 5$	-0.0301	-0.0472	-0.0214	-0.0115	-0.0278	-0.0028	-0.2459	-0.2216	-0.2448
	(1.00)	(0.17)	(0.11)	(1.00)	(0.17)	(0.11)	(1.00)	(0.26)	(0.48)

Figure 1: Size and Differences in Portfolio Performance
In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within size-sorted deciles.

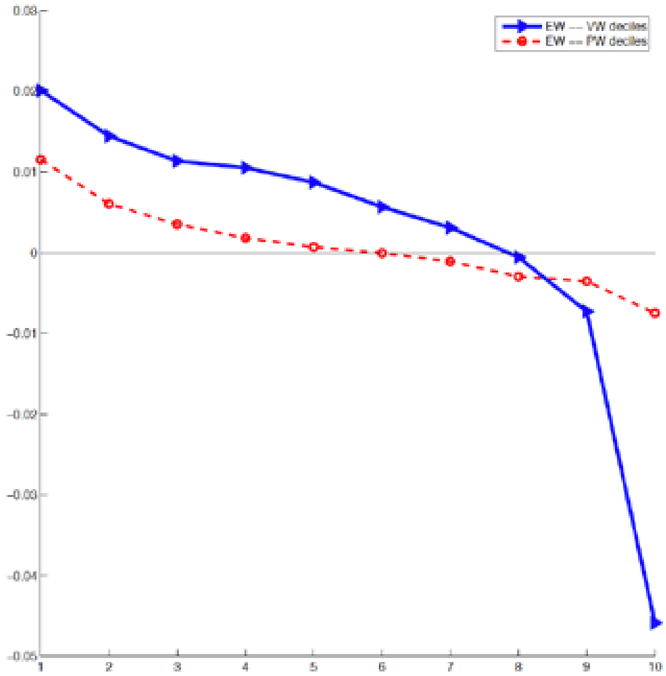


Figure 2: Book-to-Market and Differences in Portfolio Performance
In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within book-to-market sorted deciles.

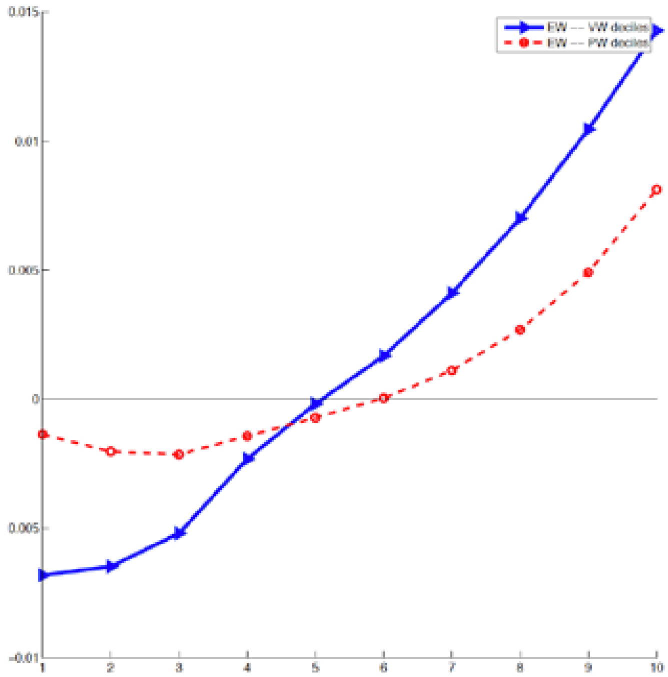


Figure 3: 3-Month Momentum and Differences in Portfolio Performance

In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within deciles sorted on the basis of 3-month momentum.

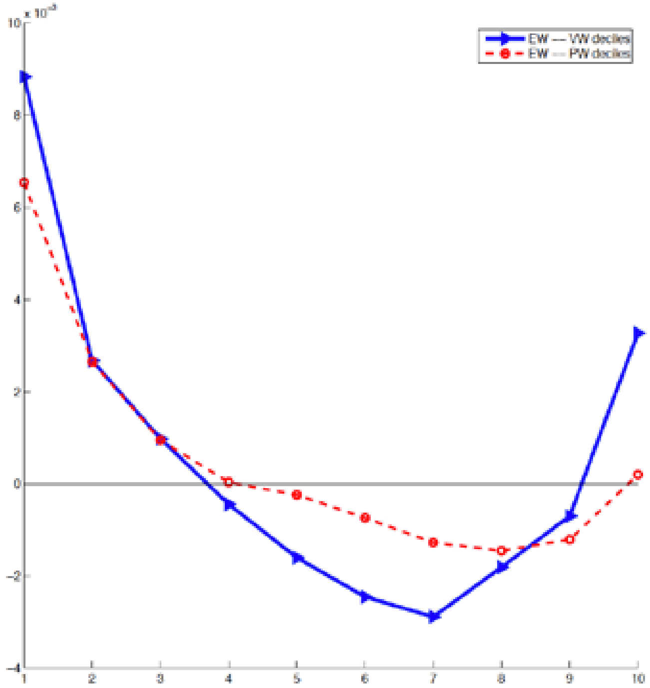


Figure 4: 12-Month Momentum and Differences in Portfolio Performance

In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within deciles sorted on the basis of 12-month momentum.

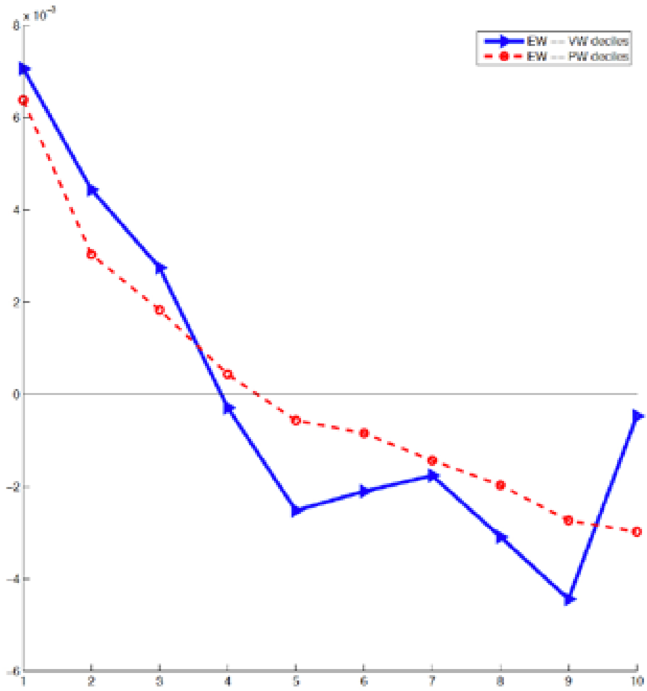


Figure 5: Reversal and Differences in Portfolio Performance

In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within deciles sorted on the basis of reversal.

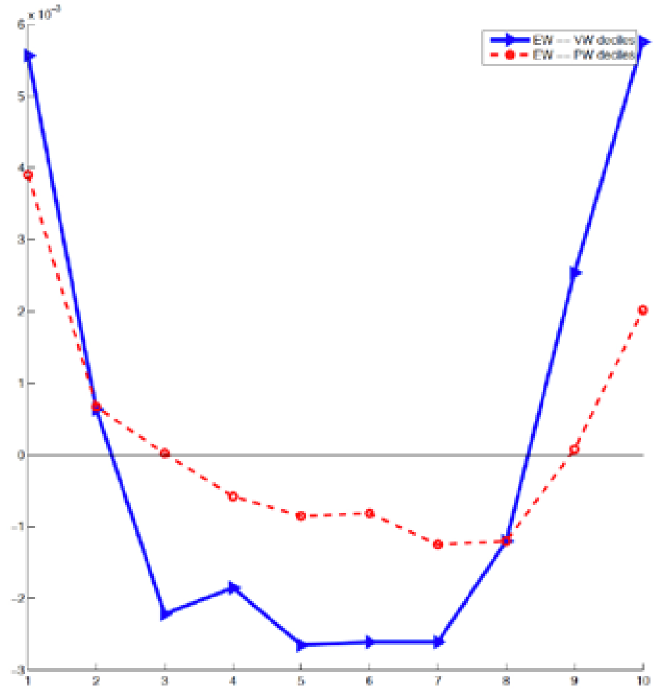


Figure 6: Price and Differences in Portfolio Performance

In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within deciles sorted on the basis of price.

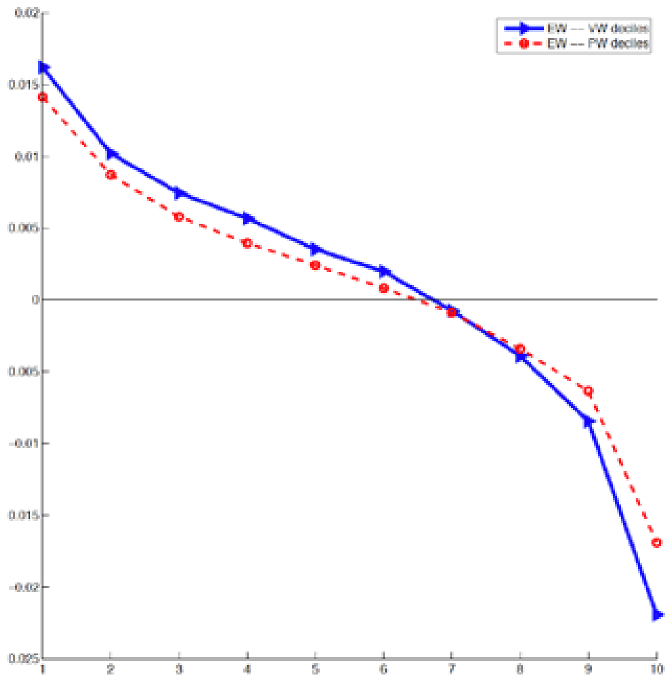


Figure 7: Liquidity and Differences in Portfolio Performance

In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within deciles sorted on the basis of liquidity.

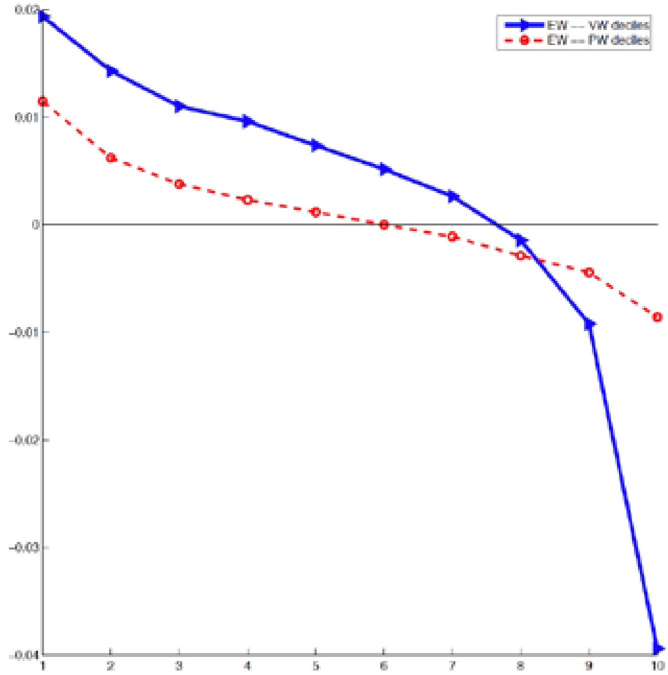
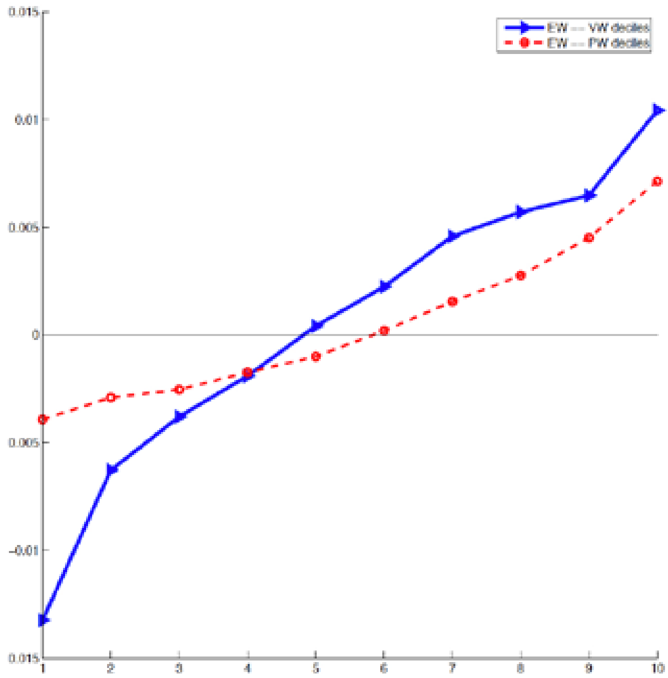


Figure 8: Idiosyncratic Volatility and Differences in Portfolio Performance

In this figure, we plot the differences between the returns on the equal- and value-weighted portfolios (blue line with triangles) and the equal- and price-weighted portfolios (red dashed line with circles) within deciles sorted on the basis of idiosyncratic volatility.



Additional Tables for Robustness Tests

Table A1: Fama and MacBeth (1973) Regressions
In this table we report the results of Fama and MacBeth (1973) regressions for S&P500 constituent stocks. Each month we regress the returns of an asset on a constant and the asset's characteristics, which are listed in the first column of the table: size, book-to-market, 3-month momentum, 12-month momentum, reversal of return, price, liquidity, and idiosyncratic volatility. The second column ("Univariate") gives us the average beta estimator when regressing the returns on an *individual* characteristic and a constant. Columns three to five give the betas from multivariate regressions, where in the first case we include all stocks characteristics except 12-month momentum, in the second case we exclude only 3-month momentum, and in the last column we exclude both 3- and 12-month momentum. Below each estimate of average beta, we report in parenthesis the p-values for the hypothesis that the estimated beta is not different from zero.

Characteristics	β			
	Univariate	Multivariate		
		excluding MOM3	excluding MOM12	excluding MOM3 & MOM12
Size	-0.0002	-0.0000	-0.0000	-0.0000
	(0.01)	(0.39)	(0.38)	(0.37)
Book to market	0.0013	0.0008	0.0008	0.0008
	(0.00)	(0.01)	(0.01)	(0.01)
Momentum: 3 month	-0.0088	-0.0011	–	–
	(0.03)	(0.40)	–	–
Momentum: 12 month	0.0022	–	-0.0010	–
	(0.23)	–	(0.40)	–
Reversal	-0.0260	-0.0279	-0.0280	-0.0274
	(0.00)	(0.00)	(0.00)	(0.00)
Price	-0.0001	-0.0000	-0.0000	-0.0000
	(0.03)	(0.12)	(0.12)	(0.10)
Liquidity	-0.0028	-0.0016	-0.0016	-0.0017
	(0.02)	(0.11)	(0.11)	(0.10)
Idiosyncratic volatility	0.0010	-0.0014	-0.0014	-0.0019
	(0.43)	(0.38)	(0.38)	(0.34)

Table A2: Portfolio Performance for S&P400 Constituent Stocks

In this table we report the performance metrics of the portfolios constructed from the constituents of the S&P400 index. All metrics are calculated using monthly returns from July 1991 to December 2009 (222 months). The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, fourfactor alpha, turnover, transaction costs, distance value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance, before transactions costs, and net of transactions costs of 50 basis points, for portfolios formed using different weighting rules: EW denotes the equal-weighted portfolio, VW the value-weighted portfolio, and PW the price-weighted portfolio.

Metrics (per year)	Performance before transaction costs			Performance net of transaction costs		
	EW	VW	PW	EW	VW	PW
Total Return	0.1334	0.1268	0.1142	0.1281	0.1246	0.1116
	(1.00)	(0.22)	(0.00)	(1.00)	(0.31)	(0.00)
Systematic Return	0.1098	0.1150	0.1126	0.1098	0.1150	0.1126
	(1.00)	(0.02)	(0.12)	(1.00)	(0.02)	(0.12)
Outperformance frequency	0.0000	0.6257	0.6731	0.0000	0.6094	0.6541
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
One-factor alpha	0.0364	0.0298	0.0229	0.0310	0.0275	0.0203
	(1.00)	(0.20)	(0.00)	(1.00)	(0.30)	(0.01)
Four-factor alpha	0.0237	0.0118	0.0016	0.0183	0.0096	-0.0010
	(1.00)	(0.08)	(0.00)	(1.00)	(0.15)	(0.00)
Turnover	1.0764	0.4551	0.5184	1.0764	0.4551	0.5184
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Transaction costs	0.0054	0.0023	0.0026	0.0054	0.0023	0.0026
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Distance to value weights	0.0737	0.0000	0.0858	0.0737	0.0000	0.0858
	(1.00)	(0.00)	(0.43)	(1.00)	(0.00)	(0.43)
Distance to price weights	0.0752	0.0858	0.0000	0.0752	0.0858	0.0000
	(1.00)	(0.17)	(0.00)	(1.00)	(0.17)	(0.00)
Volatility	0.1807	0.1743	0.1618	0.1807	0.1743	0.1618
	(1.00)	(0.10)	(0.00)	(1.00)	(0.10)	(0.00)
Skewness	-0.4807	-0.6358	-0.7018	-0.4807	-0.6358	-0.7018
	(1.00)	(0.15)	(0.01)	(1.00)	(0.15)	(0.01)
Kurtosis	6.0077	5.5355	5.7554	6.0077	5.5355	5.7554
	(1.00)	(0.12)	(0.29)	(1.00)	(0.12)	(0.29)
Max Drawdown	0.1142	0.1118	0.1057	0.1155	0.1124	0.1063
	(1.00)	(0.23)	(0.00)	(1.00)	(0.17)	(0.00)
Sharpe Ratio	0.5444	0.5265	0.4891	0.5146	0.5134	0.4730
	(1.00)	(0.32)	(0.03)	(1.00)	(0.46)	(0.08)
Sortino Ratio	0.8195	0.7807	0.7151	0.7702	0.7594	0.6896
	(1.00)	(0.28)	(0.01)	(1.00)	(0.41)	(0.05)
Treynor Ratio	0.0961	0.0896	0.0851	0.0909	0.0874	0.0824
	(1.00)	(0.19)	(0.02)	(1.00)	(0.30)	(0.04)
CEQ, $\gamma = 2$	0.1000	0.0955	0.0872	0.0946	0.0933	0.0846
	(1.00)	(0.27)	(0.00)	(1.00)	(0.39)	(0.02)
CEQ, $\gamma = 5$	0.0452	0.0440	0.0429	0.0398	0.0417	0.0403
	(1.00)	(0.41)	(0.35)	(1.00)	(0.41)	(0.46)

Table A3: Portfolio Performance for S&P600 Constituent Stocks

In this table we report the performance metrics of the portfolios constructed from the constituents of the S&P600 index. All metrics are calculated using monthly returns from February 1967 to December 2009 (182 months). The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, four-factor alpha, turnover, transaction costs, distance to value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance, before transactions costs, and net of transactions costs of 50 basis points, for portfolios formed using different weighting rules: EW denotes the equal-weighted portfolio, VW the value-weighted portfolio, and PW the price-weighted portfolio.

Metrics (per year)	Performance before transaction costs			Performance net of transaction costs		
	EW	VW	PW	EW	VW	PW
Total Return	0.1391	0.1153	0.1256	0.1325	0.1128	0.1226
	(1.00)	(0.00)	(0.04)	(1.00)	(0.01)	(0.10)
Systematic Return	0.1206	0.1238	0.1221	0.1206	0.1238	0.1221
	(1.00)	(0.12)	(0.30)	(1.00)	(0.12)	(0.30)
Outperformance frequency	0.0000	0.6533	0.6039	0.0000	0.6368	0.5893
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
One-factor alpha	0.0421	0.0224	0.0354	0.0355	0.0199	0.0324
	(1.00)	(0.01)	(0.19)	(1.00)	(0.03)	(0.35)
Four-factor alpha	0.0185	-0.0086	0.0035	0.0119	-0.0111	0.0005
	(1.00)	(0.00)	(0.03)	(1.00)	(0.00)	(0.07)
Turnover	1.3253	0.4942	0.5969	1.3253	0.4942	0.5969
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Transaction costs	0.0066	0.0025	0.0030	0.0066	0.0025	0.0030
	(1.00)	(0.00)	(0.00)	(1.00)	(0.00)	(0.00)
Distance to value weights	0.0747	0.0000	0.0631	0.0747	0.0000	0.0631
	(1.00)	(0.00)	(0.18)	(1.00)	(0.00)	(0.18)
Distance to price weights	0.0688	0.0631	0.0000	0.0688	0.0631	0.0000
	(1.00)	(0.06)	(0.00)	(1.00)	(0.06)	(0.00)
Volatility	0.2151	0.1991	0.1922	0.2151	0.1991	0.1922
	(1.00)	(0.01)	(0.00)	(1.00)	(0.01)	(0.00)
Skewness	-0.3895	-0.5945	-0.6271	-0.3895	-0.5945	-0.6271
	(1.00)	(0.08)	(0.06)	(1.00)	(0.08)	(0.06)
Kurtosis	5.2823	4.6113	4.7212	5.2823	4.6113	4.7212
	(1.00)	(0.07)	(0.10)	(1.00)	(0.07)	(0.10)
Max Drawdown	0.1462	0.1388	0.1330	0.1479	0.1395	0.1337
	(1.00)	(0.05)	(0.00)	(1.00)	(0.03)	(0.00)
Sharpe Ratio	0.4841	0.4036	0.4719	0.4533	0.3912	0.4563
	(1.00)	(0.02)	(0.37)	(1.00)	(0.06)	(0.47)
Sortino Ratio	0.7180	0.5785	0.6829	0.6683	0.5594	0.6585
	(1.00)	(0.01)	(0.30)	(1.00)	(0.04)	(0.43)
Treynor Ratio	0.0959	0.0792	0.0937	0.0898	0.0768	0.0906
	(1.00)	(0.02)	(0.39)	(1.00)	(0.05)	(0.46)
CEQ, $\gamma = 2$	0.0917	0.0743	0.0875	0.0851	0.0718	0.0845
	(1.00)	(0.02)	(0.30)	(1.00)	(0.05)	(0.47)
CEQ, $\gamma = 5$	0.0141	0.0071	0.0249	0.0074	0.0047	0.0219
	(1.00)	(0.22)	(0.09)	(1.00)	(0.37)	(0.04)

Table A4: Alpha As Rebalancing Frequency of Equal-Weighted Portfolio is Decreased for S&P400 Constituent Stocks

In this table we report the performance metrics for portfolios constructed from the constituents of the S&P400 index. In the base case, the equal-weighted portfolio is rebalanced on a monthly frequency; in the other two cases considered, the equal-weighted portfolio is rebalanced every 6 and every 12 months. The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, four-factor alpha, turnover, transaction costs, distance to value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance of the equal-weighted (EW) portfolio, the value-weighted (VW) portfolio, and the price-weighted (PW) portfolio.

Metrics (per year)	Rebalancing frequency				
	Base case: 1 month			6 month	12 month
	EW	VW	PW	EW	EW
Total Return	0.1334	0.1268	0.1142	0.1240	0.1231
	(1.00)	(0.22)	(0.00)	(0.00)	(0.01)
Systematic Return	0.1098	0.1150	0.1126	0.1128	0.1163
	(1.00)	(0.02)	(0.12)	(0.00)	(0.00)
Outperformance frequency	0.0000	0.6257	0.6731	0.6783	0.6353
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
One-factor alpha	0.0364	0.0298	0.0229	0.0284	0.0295
	(1.00)	(0.20)	(0.00)	(0.00)	(0.03)
Four-factor alpha	0.0237	0.0118	0.0016	0.0112	0.0067
	(1.00)	(0.08)	(0.00)	(0.00)	(0.00)
Turnover	1.0764	0.4551	0.5184	0.5589	0.4143
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
Transaction costs	0.0054	0.0023	0.0026	0.0028	0.0021
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance to value weights	0.0737	0.0000	0.0858	0.0723	0.0710
	(1.00)	(0.00)	(0.43)	(0.00)	(0.00)
Distance to price weights	0.0752	0.0858	0.0000	0.0744	0.0744
	(1.00)	(0.17)	(0.00)	(0.00)	(0.14)
Volatility	0.1807	0.1743	0.1618	0.1761	0.1693
	(1.00)	(0.10)	(0.00)	(0.00)	(0.00)
Skewness	-0.4807	-0.6358	-0.7018	-0.4888	-0.6675
	(1.00)	(0.15)	(0.01)	(0.41)	(0.00)
Kurtosis	6.0077	5.5355	5.7554	5.9702	5.7234
	(1.00)	(0.12)	(0.29)	(0.40)	(0.10)
Max Drawdown	0.1142	0.1118	0.1057	0.1127	0.1095
	(1.00)	(0.23)	(0.00)	(0.03)	(0.00)
Sharpe Ratio	0.5444	0.5265	0.4891	0.5045	0.5200
	(1.00)	(0.32)	(0.03)	(0.00)	(0.13)
Sortino Ratio	0.8195	0.7807	0.7151	0.7532	0.7654
	(1.00)	(0.28)	(0.01)	(0.00)	(0.07)
Treynor Ratio	0.0961	0.0896	0.0851	0.0889	0.0911
	(1.00)	(0.19)	(0.02)	(0.00)	(0.09)
CEQ, $\gamma = 2$	0.1000	0.0955	0.0872	0.0922	0.0935
	(1.00)	(0.27)	(0.00)	(0.00)	(0.04)
CEQ, $\gamma = 5$	0.0452	0.0440	0.0429	0.0403	0.0449
	(1.00)	(0.41)	(0.35)	(0.00)	(0.43)

Table A5: Alpha As Rebalancing Frequency of Equal-Weighted Portfolio is Decreased for S&P600 Constituent Stocks

In this table we report the performance metrics for portfolios constructed from the constituents of the S&P600 index. In the base case, the equal-weighted portfolio is rebalanced on a monthly frequency; in the other two cases considered, the equal-weighted portfolio is rebalanced every 6 and every 12 months. The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, four-factor alpha, turnover, transaction costs, distance to value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance of the equal-weighted (EW) portfolio, the value-weighted (VW) portfolio, and the price-weighted (PW) portfolio.

Metrics (per year)	Rebalancing frequency				
	Base case: 1 month			6 month	12 month
	EW	VW	PW	EW	EW
Total Return	0.1391	0.1153	0.1256	0.1304	0.1270
	(1.00)	(0.00)	(0.04)	(0.00)	(0.02)
Systematic Return	0.1206	0.1238	0.1221	0.1219	0.1242
	(1.00)	(0.12)	(0.30)	(0.08)	(0.01)
Outperformance frequency	0.0000	0.6533	0.6039	0.6948	0.6229
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
One-factor alpha	0.0421	0.0224	0.0354	0.0357	0.0327
	(1.00)	(0.01)	(0.19)	(0.03)	(0.06)
Four-factor alpha	0.0185	-0.0086	0.0035	0.0085	0.0027
	(1.00)	(0.00)	(0.03)	(0.00)	(0.01)
Turnover	1.3253	0.4942	0.5969	0.6756	0.4898
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
Transaction costs	0.0066	0.0025	0.0030	0.0034	0.0024
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance to value weights	0.0747	0.0000	0.0631	0.0732	0.0718
	(1.00)	(0.00)	(0.18)	(0.00)	(0.01)
Distance to price weights	0.0688	0.0631	0.0000	0.0669	0.0660
	(1.00)	(0.06)	(0.00)	(0.00)	(0.01)
Volatility	0.2151	0.1991	0.1922	0.2100	0.2090
	(1.00)	(0.01)	(0.00)	(0.02)	(0.09)
Skewness	-0.3895	-0.5945	-0.6271	-0.3987	-0.5381
	(1.00)	(0.08)	(0.06)	(0.41)	(0.12)
Kurtosis	5.2823	4.6113	4.7212	5.1101	4.6941
	(1.00)	(0.07)	(0.10)	(0.21)	(0.06)
Max Drawdown	0.1462	0.1388	0.1330	0.1447	0.1455
	(1.00)	(0.05)	(0.00)	(0.21)	(0.38)
Sharpe Ratio	0.4841	0.4036	0.4719	0.4547	0.4402
	(1.00)	(0.02)	(0.37)	(0.03)	(0.06)
Sortino Ratio	0.7180	0.5785	0.6829	0.6695	0.6390
	(1.00)	(0.01)	(0.30)	(0.03)	(0.04)
Treynor Ratio	0.0959	0.0792	0.0937	0.0913	0.0886
	(1.00)	(0.02)	(0.39)	(0.07)	(0.11)
CEQ, $\gamma = 2$	0.0917	0.0743	0.0875	0.0853	0.0819
	(1.00)	(0.02)	(0.30)	(0.03)	(0.05)
CEQ, $\gamma = 5$	0.0141	0.0071	0.0249	0.0118	0.0079
	(1.00)	(0.22)	(0.09)	(0.28)	(0.16)

Table A6: Alpha When Weights of Value- and Price-Weighted Portfolios Held Constant for S&P400 Constituent Stocks For Increasing Periods
In this table we report the performance metrics for portfolios constructed from the constituents of the S&P400 index. In the base case, the weights of the value- and price-weighted portfolio are fixed for a month, and are revised at the end of the month. In the other two cases considered, the weights of the of the value- and price-weighted portfolios are reset each month so that they are the same as the initial weights at $t = 0$. Only after 6 months (12 months) have elapsed, do we set the weights to be the true value- and price-weighted weights. Then, again for the next 6 months (12 months), we reset the weights of the value- and price-weighted portfolios each months so that they are equal to the weights for these portfolios at the 6-month (12-month) date. Only after another 6 months (12 months) have elapsed do we set the weights to be the true value and price-weighted weights at $t = 6$ ($t = 12$) months. All metrics are calculated using monthly returns from February 1967 to December 2009. The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, four-factor alpha, turnover, transaction costs, distance to value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance of the equal-weighted (EW) portfolio, the value-weighted (VW) portfolio, and the price-weighted (PW) portfolio.

Metrics (per year)	Weights fixed for						
	Base case: 1 month			6 month		12 month	
	EW	VW	PW	VW	PW	VW	PW
Total Return	0.1334	0.1268	0.1142	0.1280	0.1214	0.1324	0.1255
	(1.00)	(0.43)	(0.00)	(0.44)	(0.03)	(0.83)	(0.12)
Systematic Return	0.1098	0.1150	0.1126	0.1136	0.1124	0.1060	0.1066
	(1.00)	(0.03)	(0.24)	(0.14)	(0.29)	(0.18)	(0.16)
Outperformance frequency	0.0000	0.6257	0.6731	0.6151	0.6497	0.5991	0.6492
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
One-factor alpha	0.0364	0.0298	0.0229	0.0294	0.0277	0.0322	0.0302
	(1.00)	(0.40)	(0.00)	(0.30)	(0.07)	(0.48)	(0.21)
Four-factor alpha	0.0237	0.0118	0.0016	0.0144	0.0090	0.0263	0.0189
	(1.00)	(0.17)	(0.00)	(0.20)	(0.01)	(0.74)	(0.36)
Turnover	1.0764	0.4551	0.5184	1.4176	1.2977	1.3737	1.2339
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Transaction costs	0.0054	0.0023	0.0026	0.0071	0.0065	0.0069	0.0062
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance to value weights	0.0737	0.0000	0.0858	0.0241	0.0872	0.0378	0.0890
	(1.00)	(0.00)	(0.86)	(0.00)	(0.89)	(0.00)	(0.98)
Distance to price weights	0.0752	0.0858	0.0000	0.0881	0.0207	0.0914	0.0314
	(1.00)	(0.33)	(0.00)	(0.19)	(0.00)	(0.03)	(0.00)
Volatility	0.1807	0.1743	0.1618	0.1794	0.1684	0.1848	0.1739
	(1.00)	(0.19)	(0.00)	(0.74)	(0.00)	(0.30)	(0.08)
Skewness	-0.4807	-0.6358	-0.7018	-0.6538	-0.6740	-0.4529	-0.4517
	(1.00)	(0.30)	(0.03)	(0.12)	(0.05)	(0.78)	(0.75)
Kurtosis	6.0077	5.5355	5.7554	5.7364	5.9104	5.9229	6.1065
	(1.00)	(0.24)	(0.58)	(0.50)	(0.81)	(0.79)	(0.85)
Max Drawdown	0.1142	0.1118	0.1057	0.1153	0.1084	0.1161	0.1100
	(1.00)	(0.46)	(0.00)	(0.73)	(0.09)	(0.55)	(0.26)
Sharpe Ratio	0.5444	0.5265	0.4891	0.5183	0.5123	0.5268	0.5199
	(1.00)	(0.63)	(0.06)	(0.48)	(0.27)	(0.60)	(0.37)
Sortino Ratio	0.8195	0.7807	0.7151	0.7663	0.7547	0.7952	0.7829
	(1.00)	(0.56)	(0.02)	(0.39)	(0.18)	(0.65)	(0.44)
Treynor Ratio	0.0961	0.0896	0.0851	0.0886	0.0891	0.0906	0.0910
	(1.00)	(0.38)	(0.03)	(0.26)	(0.15)	(0.36)	(0.29)
CEQ, $\gamma = 2$	0.1000	0.0955	0.0872	0.0948	0.0921	0.0974	0.0945
	(1.00)	(0.54)	(0.01)	(0.42)	(0.11)	(0.65)	(0.26)
CEQ, $\gamma = 5$	0.0452	0.0440	0.0429	0.0395	0.0438	0.0400	0.0441
	(1.00)	(0.81)	(0.70)	(0.42)	(0.83)	(0.48)	(0.86)

Table A7: Alpha When Weights of Value- and Price-Weighted Portfolios Held Constant for S&P600 Constituent Stocks For Increasing Periods
In this table we report the performance metrics for portfolios constructed from the constituents of the S&P600 index. In the base case, the weights of the value- and price-weighted portfolio are fixed for a month, and are revised at the end of the month. In the other two cases considered, the weights of the of the value- and price-weighted portfolios are reset each month so that they are the same as the initial weights at $t = 0$. Only after 6 months (12 months) have elapsed, do we set the weights to be the true value- and price-weighted weights. Then, again for the next 6 months (12 months), we reset the weights of the value- and price-weighted portfolios each months so that they are equal to the weights for these portfolios at the 6-month (12-month) date. Only after another 6 months (12 months) have elapsed do we set the weights to be the true value and price-weighted weights at $t = 6$ ($t = 12$) months. All metrics are calculated using monthly returns from February 1967 to December 2009. The first column gives the names of the various metrics we use to measure portfolio performance on a per annum basis, which are: total mean portfolio return, systematic return for bearing factor risk (estimated from the 4-factor asset pricing model of Fama and French (1993) and Carhart (1997) using market, size, value and momentum factors), outperformance frequency of equal-weighted portfolio, one-factor alpha from the market model, fourfactor alpha, turnover, transaction costs, distance to value weights, distance to price weights, volatility (standard deviation) of portfolio returns, skewness, kurtosis, average value of the maximum portfolio drawdown, Sharpe ratio, Sortino ratio, Treynor ratio, certainty equivalent for an investor who has a power utility function with the relative risk aversion and coefficient $\gamma = 2$ and $\gamma = 5$. The remaining columns report the performance of the equal-weighted (EW) portfolio, the value-weighted (VW) portfolio, and the price-weighted (PW) portfolio.

Metrics (per year)	Weights fixed for						
	Base case: 1 month			6 month		12 month	
	EW	VW	PW	VW	PW	VW	PW
Total Return	0.1391	0.1153	0.1256	0.1239	0.1346	0.1201	0.1306
	(1.00)	(0.00)	(0.08)	(0.08)	(0.56)	(0.05)	(0.28)
Systematic Return	0.1206	0.1238	0.1221	0.1194	0.1193	0.1188	0.1187
	(1.00)	(0.24)	(0.59)	(0.71)	(0.62)	(0.56)	(0.51)
Outperformance frequency	0.0000	0.6533	0.6039	0.6287	0.5692	0.6500	0.6005
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
One-factor alpha	0.0421	0.0224	0.0354	0.0286	0.0420	0.0246	0.0377
	(1.00)	(0.01)	(0.38)	(0.11)	(0.99)	(0.05)	(0.59)
Four-factor alpha	0.0185	-0.0086	0.0035	0.0044	0.0153	0.0013	0.0119
	(1.00)	(0.00)	(0.06)	(0.11)	(0.69)	(0.06)	(0.41)
Turnover	1.3253	0.4942	0.5969	1.6230	1.5387	1.5934	1.4903
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Transaction costs	0.0066	0.0025	0.0030	0.0081	0.0077	0.0080	0.0075
	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance to value weights	0.0747	0.0000	0.0631	0.0275	0.0665	0.0418	0.0702
	(1.00)	(0.00)	(0.36)	(0.00)	(0.36)	(0.00)	(0.37)
Distance to price weights	0.0688	0.0631	0.0000	0.0679	0.0243	0.0734	0.0359
	(1.00)	(0.12)	(0.00)	(0.90)	(0.00)	(0.35)	(0.00)
Volatility	0.2151	0.1991	0.1922	0.2039	0.1967	0.2062	0.1988
	(1.00)	(0.01)	(0.00)	(0.02)	(0.00)	(0.03)	(0.00)
Skewness	-0.3895	-0.5945	-0.6271	-0.6119	-0.6260	-0.6175	-0.6333
	(1.00)	(0.17)	(0.12)	(0.04)	(0.02)	(0.04)	(0.01)
Kurtosis	5.2823	4.6113	4.7212	4.9097	5.0336	4.8755	4.9762
	(1.00)	(0.13)	(0.20)	(0.38)	(0.57)	(0.33)	(0.48)
Max Drawdown	0.1462	0.1388	0.1330	0.1403	0.1333	0.1447	0.1374
	(1.00)	(0.09)	(0.00)	(0.14)	(0.00)	(0.72)	(0.04)
Sharpe Ratio	0.4841	0.4036	0.4719	0.4365	0.5069	0.4133	0.4817
	(1.00)	(0.04)	(0.75)	(0.24)	(0.55)	(0.09)	(0.96)
Sortino Ratio	0.7180	0.5785	0.6829	0.6282	0.7388	0.5916	0.6973
	(1.00)	(0.02)	(0.60)	(0.17)	(0.74)	(0.06)	(0.74)
Treynor Ratio	0.0959	0.0792	0.0937	0.0843	0.0988	0.0803	0.0943
	(1.00)	(0.04)	(0.78)	(0.14)	(0.72)	(0.06)	(0.82)
CEQ, $\gamma = 2$	0.0917	0.0743	0.0875	0.0808	0.0946	0.0760	0.0898
	(1.00)	(0.04)	(0.60)	(0.19)	(0.73)	(0.07)	(0.80)
CEQ, $\gamma = 5$	0.0141	0.0071	0.0249	0.0095	0.0285	0.0029	0.0221
	(1.00)	(0.45)	(0.19)	(0.61)	(0.08)	(0.28)	(0.35)

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