Implementation Details and Robustness Checks

Appendix to "Optimal versus Naive Diversification:
How Inefficient Is the $1/N$ Portfolio Strategy?"

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Preface to this document

This document is a separate appendix for the manuscript, "Optimal versus Naive Diversification: How Inefficient Is the $1/N$ Portfolio Strategy?" In Section A of this document, we report the implementation details of the various portfolio strategies considered in the paper. In Section B, we give the results for the various experiments undertaken to determine how the numbers for the benchmark set of experiments reported in the manuscript are affected by changes in the assumptions made when analyzing the empirical performance of the different models of optimal portfolio choice. The actual tables with all these results are collected in Section C.

A Implementation details for some of the models of optimal portfolio choice

In this section, we provide additional details about the implementation of some of the models of optimal portfolio selection that were described in the paper.

A.1 Bayes-Stein shrinkage portfolio

In our analysis of the Bayes-Stein shrinkage portfolio, we use the estimator proposed by Jorion (1985, 1986) who takes the grand mean, $\overline{\mu}$, to be the mean of the minimum-variance portfolio, $\mu^{\min}$. More specifically, following Jorion (1986), the estimator we use for expected returns is:

$$\hat{\mu}_t^{\text{bs}} = (1-\hat{\phi}_t)\,\hat{\mu}_t + \hat{\phi}_t\,\hat{\mu}_t^{\min}, \tag{1}$$

$$\hat{\phi}_t = \frac{N+2}{(N+2)+M(\hat{\mu}_t-\mu_t^{\min})^{\top}\hat{\Sigma}_t^{-1}(\hat{\mu}_t-\mu_t^{\min})}, \tag{2}$$

in which $\hat{\Sigma}_t = \frac{1}{M-N-2}\sum_{s=t-M+1}^{t}(R_s-\hat{\mu}_t)(R_s-\hat{\mu}_t)^{\top}$, and $\hat{\mu}_t^{\min} \equiv \hat{\mu}_t^{\top}\hat{\mathrm{w}}_t^{\min}$ is the average excess return on the sample global minimum-variance portfolio, $\hat{\mathrm{w}}_t^{\min}$.

The implementation in Jorion (1986) accounts *also* for estimation error in the covariance matrix via a traditional Bayesian estimation. To accomplish this, Jorion (1986), derives first the predictive variance of asset returns starting from an informative prior on μ with precision τ, and then uses the sample estimates of Σ and τ to obtain the following expression for the covariance matrix that is utilized in portfolio construction:

$$\hat{\Sigma}_t^{\text{bs}} = \hat{\Sigma}_t\left(1+\frac{1}{M+\hat{\tau}_t}\right) + \frac{\hat{\tau}_t}{M(M+1+\hat{\tau}_t)}\frac{\mathbf{1}_N\mathbf{1}_N^{\top}}{\mathbf{1}_N^{\top}\hat{\Sigma}_t^{-1}\mathbf{1}_N}, \tag{3}$$

$$\hat{\tau}_t = M\frac{\hat{\phi}_t}{1-\hat{\phi}_t}. \tag{4}$$

The portfolio obtained by using $\hat{\mu}_t^{\text{bs}}$ and $\hat{\Sigma}_t^{\text{bs}}$ is:

$$\hat{\mathrm{w}}_t^{\text{bs}} = \frac{\left(\hat{\Sigma}_t^{\text{bs}}\right)^{-1}\hat{\mu}_t^{\text{bs}}}{\mathbf{1}_N^{\top}\left(\hat{\Sigma}_t^{\text{bs}}\right)^{-1}\hat{\mu}_t^{\text{bs}}}, \tag{5}$$

which combines both a shrinkage approach and a traditional Bayesian estimation, and hence, is known as the "Bayes-Stein" portfolio.

A.2 Bayesian "Data-and-Model" portfolio

For evaluating the Bayesian "Data-and-Model" approach in Pástor (2000), we assume that the market is composed of N risky assets and one risk-free asset. The N risky assets include K factors. The excess returns of the remaining $N-K$ risky assets follow the factor model defined below:

$$R_{a,t} = \alpha + BR_{b,t} + \epsilon_t. \tag{6}$$

Then, the "true" mean vector and variance-covariance matrix of returns are:

$$\mu = \begin{pmatrix} \mu_a \\ \mu_b \end{pmatrix}, \quad \Sigma = \begin{pmatrix} B\Sigma_{bb}B^\top + \Sigma_\epsilon & B\Sigma_{bb} \\ \Sigma_{bb}B^\top & \Sigma_{bb} \end{pmatrix}, \tag{7}$$

in which Σ_{bb} is the variance-covariance matrix of the returns on the factors. If the asset-pricing model is correct, then $\mu_a = B\mu_b$ and the mispricing term α is zero.

Let $\hat{B}$ and $\hat{\Sigma}_\epsilon$ be the maximum likelihood estimators of the factor loadings B and of the variance-covariance matrix of residuals, Σ_ϵ, obtained by estimating the unrestricted regression in (6). These will be the estimators chosen by an investor who completely ignores the prediction of the asset pricing model. Similarly, let $\overline{B}$ and $\overline{\Sigma}_\epsilon$ be the quantities obtained by estimating the model (6) with the restriction that $\alpha = 0$. These would be the estimators chosen by an investor who dogmatically believes in the asset-pricing model.

A Bayesian investor expresses his confidence in the asset-pricing model by postulating a *prior* belief on the mispricing term, α. The prior on α, conditional on Σ_ϵ, is assumed to have a Normal distribution with a mean of zero and variance $\tau\Sigma_\epsilon$, that is, $p(\alpha|\Sigma_\epsilon) = \mathcal{N}(0, \tau\Sigma_\epsilon)$, with τ determining the precision of the prior belief over the validity of the asset-pricing model.[1] Finally, let $\hat{\mu}_a$ denote the sample mean of the return on the assets, R_{at}, and $\hat{\mu}_b$ and $\hat{\Sigma}_{bb}$ be, respectively, the sample mean and variance of returns on the factors, R_{bt}.

Under the assumptions described above, Wang (2005) shows how to obtain estimators for the mean vector and covariance matrix of asset returns that account for a Bayesian investor's belief about the validity of a particular asset-pricing model. More specifically, (see Wang (2005, Theorem 1)) if one denotes by $\hat{S}^2 = \hat{\mu}_b^\top \hat{\Sigma}_{bb}^{-1} \hat{\mu}_b$ the square of the highest Sharpe ratio of the efficient frontier spanned by the mean and variance of the factor portfolios, and by

$$\omega = \frac{1}{1 + M\tau/(1+\hat{S}^2)} \tag{8}$$

the degree of confidence a Bayesian investor places in the asset pricing model (that is, $\omega = 1$ implies dogmatic belief in the model), then a Bayesian Data-and-Model ("dm") investor with a degree of confidence ω in the model will use the following *shrinkage* estimators of the expected return and variance-covariance matrix:

$$\mu^{\mathrm{dm}} = \omega \begin{pmatrix} \overline{B}\hat{\mu}_a \\ \hat{\mu}_b \end{pmatrix} + (1-\omega) \begin{pmatrix} \hat{\mu}_a \\ \hat{\mu}_b \end{pmatrix}, \tag{9}$$

$$\Sigma^{\mathrm{dm}} = \begin{pmatrix} \Sigma_{aa}^{\mathrm{dm}}(\omega) & \Sigma_{ab}^{\mathrm{dm}}(\omega) \\ \Sigma_{ab}^{\mathrm{dm}}(\omega)^\top & \Sigma_{bb}^{\mathrm{dm}}(\omega) \end{pmatrix}, \tag{10}$$

in which

$$\begin{aligned} \Sigma_{aa}^{\mathrm{dm}}(\omega) &= \kappa\left(\omega\overline{B} + (1-\omega)\hat{B}\right)\hat{\Sigma}_{bb}\left(\omega\overline{B} + (1-\omega)\hat{B}\right)^\top \\ &\quad + h\left(\omega\overline{\delta} + (1-\omega)\hat{\delta}\right)\left(\omega\overline{\Sigma}_\epsilon + (1-\omega)\hat{\Sigma}_\epsilon\right), \end{aligned} \tag{11}$$

$$\Sigma_{ab}^{\mathrm{dm}}(\omega) = \kappa\left(\omega\overline{B} + (1-\omega)\hat{B}\right)\hat{\Sigma}_{bb}, \tag{12}$$

$$\Sigma_{bb}^{\mathrm{dm}}(\omega) = \kappa\hat{\Sigma}_{bb}, \tag{13}$$

[1] The priors on the factor loadings, B, on the variance-covariance of the residuals, Σ_ϵ, as well as on the expected returns and variance-covariance matrix of the factors, are assumed to be non-informative because the asset-pricing model does not impose any restrictions on these parameters.

and

$$\overline{\delta} = \frac{M(M-2)+K}{M(M-K-2)} - \frac{k+3}{M(M-K-2)} \cdot \frac{\hat{S}^2}{1+\hat{S}^2}, \tag{14}$$

$$\hat{\delta} = \frac{(M-2)(M+1)}{M(M-K-2)}, \tag{15}$$

$$\kappa = \frac{M+1}{M-K-2}, \tag{16}$$

$$h = \frac{M}{M-N-1}. \tag{17}$$

Observe, from Equation (9) that the parameter ω acts as a *linear* shrinkage factor for the mean returns, and from Equation (11) as a *quadratic* shrinkage factor for the variance of the returns on the assets. The resulting portfolio weights at each time t are given by

$$\hat{\mathrm{w}}_t^{\mathrm{dm}} = \frac{\left(\hat{\Sigma}_t^{\mathrm{dm}}\right)^{-1} \hat{\mu}_t^{\mathrm{dm}}}{\mathbf{1}_N^\top \left(\hat{\Sigma}_t^{\mathrm{dm}}\right)^{-1} \hat{\mu}_t^{\mathrm{dm}}}. \tag{18}$$

In our implementation, we assume that the tightness of the investor's view about the mispricing α is given by σ_α. To insure that the prior variances on α are consistent with this assumption, we need to ensure that the variance of the prior, i.e., the diagonal elements of $\tau\Sigma_\epsilon$, are not higher than the assumed variance of the prior σ_α^2. We achieve this by choosing τ so that $\tau \max(\mathrm{diag}(\Sigma_\epsilon)) = \sigma_\alpha^2$. Once τ is chosen, the values of ω are obtained from (8).

A.3 Portfolios implied by asset-pricing models with unobservable factors

The optimal portfolio strategy from MacKinlay and Pastor (2000), denoted, x^{mp}, is

$$\mathrm{x}^{\mathrm{mp}} = \frac{1}{\gamma}\Sigma^{-1}\mu = \frac{1}{\gamma}\frac{1}{\sigma^2}\left(I - \frac{\nu\mu\mu^\top}{\sigma^2 + \nu\mu^\top\mu}\right)\mu = \frac{1}{\gamma(\sigma^2+\nu\mu^\top\mu)}\mu, \tag{19}$$

in which ν, μ and σ^2 are obtained by maximizing the likelihood function obtained by imposing the structure described in Equation (7) of the manuscript on the residual covariance matrix. Instead of implementing this strategy by numerically optimizing the log-likelihood function, we follow the approach suggested by Kan and Zhou (2005), who show that the MacKinlay and Pastor portfolio can be approximated as

$$\hat{\mathrm{x}}_t^{\mathrm{mp}} \approx \frac{\tilde{\mu}_t}{\gamma(\hat{\eta}_{1t} - \tilde{\mu}_t^\top\tilde{\mu}_t)}, \tag{20}$$

in which $\hat{\eta}_{1t}$ is the largest eigenvalue of the matrix $\widehat{\Sigma}_t + \hat{\mu}_t\hat{\mu}_t^\top$, $\hat{\mu}_t$ and $\widehat{\Sigma}_t$ are the sample mean and covariance, and $\tilde{\mu}_t = (\hat{q}_{1t}\hat{\mu}_t\hat{q}_{1t})$, with $\hat{q}_{1t}$ the eigenvector associated with $\hat{\eta}_{1t}$. The corresponding normalized portfolio weights simplify to $\hat{\mathrm{w}}_t^{\mathrm{mp}} \approx \tilde{\mu}_t/\mathbf{1}_N^\top\tilde{\mu}_t$. Note that for $\tilde{\mu}_t \propto \mathbf{1}_N$, this strategy corresponds to the $1/N$ portfolio. Clearly the performance of this rule depends on how reasonable is the restriction in Equation (7) of the manuscript.

A.4 Optimal "Three-Fund" portfolio

After choosing the parameters c and d in Equation (10) of the manuscript to maximize the expected utility of a mean-variance investor, Kan and Zhou (2005) propose the following ("mv-min") weights:

$$\hat{\mathrm{x}}^{\text{mv-min}} = \frac{(M-N-1)(M-N-4)}{\gamma\, M\,(M-2)}\left[\left(\frac{\hat{\psi}_a^2}{\hat{\psi}_a^2 + \frac{N}{M}}\right)\hat{\Sigma}^{-1}\hat{\mu} + \left(\frac{\frac{N}{M}}{\hat{\psi}_a^2 + \frac{N}{M}}\right)\hat{\mu}^{\min}\hat{\Sigma}^{-1}\mathbf{1}_N\right], \tag{21}$$

in which, defining the Incomplete Beta function by $B_x(a,b) = \int_0^x y^{a-1}(1-y)^{b-1}dy$,

$$\hat{\psi}_a^2 = \frac{(M-N-1)\hat{\psi}^2 - (N-1)}{M} + \frac{2(\hat{\psi}^2)^{\frac{N-1}{2}}(1+\hat{\psi}^2)^{-\frac{M-2}{2}}}{M\, B_{\hat{\psi}^2/(1+\hat{\psi}^2)}((N-1)/2,(M-N+1)/2)}, \tag{22}$$

$$\hat{\psi}^2 = (\hat{\mu} - \hat{\mu}^{\min})^\top \hat{\Sigma}^{-1}(\hat{\mu} - \hat{\mu}^{\min}). \tag{23}$$

A.5 Combination of minimum-variance strategy and the naive $1/N$ strategy

Because the investor is assumed to be ignoring expected returns, the expected-utility maximization is equivalent to minimizing the portfolio variance in which Σ is unknown. Therefore, the objective is to minimize the expected portfolio variance:

$$\min_{c,d} \text{ variance}(c,d) = \frac{1}{2}E\left[\left(c\frac{1}{N}\mathbf{1}_N + d\,\hat{\Sigma}^{-1}\mathbf{1}_N\right)^\top \Sigma \left(c\frac{1}{N}\mathbf{1}_N + d\,\hat{\Sigma}^{-1}\mathbf{1}_N\right)\right] \tag{24}$$

$$= \frac{1}{2}E\left[\frac{c^2}{N^2}\mathbf{1}_N^\top\Sigma\mathbf{1}_N + d^2\mathbf{1}_N^\top\hat{\Sigma}^{-1}\Sigma\hat{\Sigma}^{-1}\mathbf{1}_N + 2\frac{c\,d}{N}\mathbf{1}_N^\top\Sigma\hat{\Sigma}^{-1}\mathbf{1}_N\right]. \tag{25}$$

Let $W \equiv \Sigma^{-\frac{1}{2}}\widehat{\Sigma}\Sigma^{-\frac{1}{2}}$. Then, $W^{-1} = \Sigma^{\frac{1}{2}}\widehat{\Sigma}^{-1}\Sigma^{\frac{1}{2}}$ and $W^{-2} = \Sigma^{\frac{1}{2}}\widehat{\Sigma}^{-1}\Sigma\widehat{\Sigma}^{-1}\Sigma^{\frac{1}{2}}$. The expectation in (25) may hence be written as

$$\frac{c^2}{2N^2}\mathbf{1}_N^\top\Sigma\mathbf{1}_N + E\left[\frac{1}{2}d^2\mathbf{1}_N^\top\Sigma^{-1/2}W^{-2}\Sigma^{-1/2}\mathbf{1}_N + \frac{c\,d}{N}\mathbf{1}_N^\top\Sigma\Sigma^{-1/2}W^{-1}\Sigma^{-1/2}\mathbf{1}_N\right]. \tag{26}$$

Because $M\,W \sim \mathcal{W}_N(M-1, I_N)$, it follows that (see Haff (1979)):

$$E[W^{-1}] = \left(\frac{M}{M-N-2}\right)I_N \tag{27}$$

$$E[W^{-2}] = kI_N, \tag{28}$$

in which

$$k = \frac{M^2(M-2)}{(M-N-1)(M-N-2)(M-N-4)}. \tag{29}$$

Thus, the minimized portfolio variance is

$$\text{variance}(c,d) = \frac{c^2}{2N^2}\mathbf{1}_N^\top\Sigma\mathbf{1}_N + \frac{1}{2}k\,d^2\mathbf{1}_N^\top\Sigma^{-1}\mathbf{1}_N + \frac{M\,c\,d}{M-N-2}. \tag{30}$$

We want to find the values of c and d that minimize the expected value in (30) subject to the constraint that the portfolio weights sum up to one. By writing the corresponding first-order optimality conditions, and simplifying, one gets: $c = 1 - d\mathbf{1}_N^\top\Sigma^{-1}\mathbf{1}_N$, and

$$d = \frac{(M-N-2)(\mathbf{1}_N^\top\Sigma\mathbf{1}_N)(\mathbf{1}_N^\top\Sigma^{-1}\mathbf{1}_N) - N^2M}{N^2(M-N-2)k(\mathbf{1}_N^\top\Sigma^{-1}\mathbf{1}_N) - 2M\,N^2(\mathbf{1}_N^\top\Sigma^{-1}\mathbf{1}_N) + (M-N-2)(\mathbf{1}_N^\top\Sigma^{-1}\mathbf{1}_N)^2(\mathbf{1}_N^\top\Sigma\mathbf{1}_N)}.$$

B Discussion of robustness-check experiments

In this section, we discuss the results of the various experiments undertaken to evaluate the robustness of the results reported in the paper.

These experiments are:

1. Different estimation window length, $M = 60$, instead of $M = 120$;
2. Increasing estimation window, rather than a rolling window;
3. Different holding period, which is 12 months, instead of 1 month;
4. Portfolios that include the riskfree asset, rather than the portfolio of only-risky assets;
5. Portfolios that exclude the factors as investable assets;
6. Benchmark is $1/N$-buy-and-hold, and not $1/N$-with-rebalancing;
7. Different levels of risk aversion;
8. Different levels of confidence in the asset-pricing model.

The results for these eight experiments are discussed below. The tables containing the results for these experiments are in the next section, Section C, where the subsection numbers match the numbering for the subsections below. For completeness, we start out by reporting the tables for the benchmark case that are already reported in the manuscript (these are Tables 3, 4, and 5 in the manuscript, with the addition of Table 6, which contains the ranking of the various strategies based on the three performance metrics: Sharpe ratio, CEQ, and turnover). Then, we report the tables with the Sharpe ratio, CEQ returns, turnover, and rankings for eight experiments.

The particular experiment being considered can be identified by the section header, and also by the "identifier" that is typed under the title of each table. This "identifier" is made up of several "tags," where each tag indicates the particular choice being considered for that experiment. These choices and their corresponding "tags" are listed below:

Choice	Benchmark case	Tag	Alternative(s)	Tag
Portfolio evaluated	Risky-only assets	`RO`	Riskfree *and* risky assets	`All`
Estimation window length	120 months	`M120`	60 months	`M60`
Level of risk aversion	$\gamma = 1$	`gamma1`	$\gamma = \{2, 3, 4, 5, 10\}$	`gamma` γ
Subjective prior belief	$\sigma_\alpha = 1\%$	`sigAlpha0.010`	$\sigma_\alpha = \{0.005, 0.02\}$	`sigAlpha` σ_α
Investment horizon-period	1 month	`hp1`	12 months	`hp12`
Can/not invest in factors	Can invest	`InvestableFactors`	Cannot invest	`NonInvestableFactors`
Estimation window	Rolling	`Rolling`	Increasing	`Increasing`
Benchmark portfolio	$1/N$-with-rebalancing	`ewRebal`	$1/N$-without rebalancing	`ewBuyHold`

B.1 Different lengths of the estimation window

We have reported results for the empirical datasets only for the case in which the length of the estimation window is $M = 120$ months. We considered also the case of $M = 60$ months. Having a smaller estimation window typically reduces the performance of the optimal models of asset allocation. However, as the analytical results of Section 5 of the manuscript and the simulation-based results of Section 6 of the manuscript show, large changes in the length of the estimation window are needed before there is a significant effect on the performance of the optimal models of portfolio choice. This is especially true for the best-performing strategies, which are ones that rely on estimates of the variance-covariance matrix but ignore estimates of expected returns, such as minimum-variance, minimum-variance-constrained, and the generalized-minimum-variance-constrained. Thus, the rankings of the different strategies for the case of $M = 60$ are virtually the same as for the case of $M = 120$ reported in the paper.

B.2 Increasing estimation window, rather than rolling window

The results reported in the paper are for the case in which estimation is done using a rolling window, that is, where we drop the earliest observation when adding a new observation. We considered also the case in which the estimation window is *increasing* over time, that is, where we do *not* drop the last observation when we add a new observation. We find that the performance of the optimizing strategies improves only slightly in this case. The intuition for this, as mentioned above, is that small changes in the estimation window have only a negligible effect on performance.

B.3 Different holding periods

The results we present are for a holding period of one month, given that the frequency of returns in our datasets is monthly. Because Chan, Karceski, and Lakonishok (1999) and Jagannathan and Ma (2003) consider a holding period of one year, we studied also a holding period of one year and found that it does not affect our qualitative results. The results are almost the same as the ones reported for the benchmark case in the paper.[2]

B.4 Portfolios that include the risk-free asset

In the paper, we report results for the performance of the fund of *only-risky assets*, rather than the performance of the overall portfolio, which consists of both the riskless asset and the risky assets. The reason for making this choice was that we wanted to focus on the effect of asset allocation alone, and if one considered the performance of the overall portfolio, then that would depend also on market-timing ability.

If one can hold also the risk-free asset, then for some portfolios there is no change at all in the Sharpe ratio, CEQ returns, and turnover; these are the minimum-variance portfolio, the minimum-variance-constrained portfolio, the generalized-minimum-variance-constrained portfolio, the value-weighted portfolio, and the mixture of the equally-weighted and the minimum-variance portfolio. For the other policies, there are small changes. In terms of Sharpe ratio, the $1/N$ strategy now ranks fifth instead of sixth. In terms of CEQ returns, the rank of the $1/N$ strategy drops from second to eighth, though there is still no optimal strategy that consistently outperforms $1/N$.

B.5 Portfolios that exclude the factors as investable assets

In the results that we have reported, we have assumed that the factor portfolios driving returns are available also as investable assets. The factor portfolios in the various datasets are the U.S. equity market portfolio, the World market portfolio, and the Fama-French factor portfolios SMB, HML, and the momentum portfolio, UMD. When we consider the case in which these factor portfolios are *not* available as investable assets, the variance-covariance matrix is better behaved, and so the performances of strategies that rely on just minimizing the portfolio variance improve. These strategies are the minimum-variance portfolio, the Bayes-Stein shrinkage portfolio, the minimum-variance-constrained strategy, and the mixture of the equally-weighted and minimum-variance portfolios. Despite this improvement, the Sharpe ratio of the $1/N$ maintains its rank of sixth, and in terms of CEQ drops in rank from second to fourth, while continuing to be the best in terms of turnover.

[2] Also, the Sharpe ratio we report for the myopic portfolio choice models is a one-period Sharpe ratio; that is, it is computed for the case in which agents care about wealth next period. In principle, one might be interested also in the long-horizon Sharpe ratio, that is, the Sharpe ratio computed over the entire holding period of the portfolio. We address this concern in our simulations by considering also the experiment in which we simulate many *paths* of returns, and computing the Sharpe ratio for terminal wealth across these paths (instead of across realizations for a single path); we find that the qualitative insights from these long-horizon Sharpe ratios are similar to the ones that are reported in the paper. These results, because they rely on simulations, are not included in the separate appendix, "Tables with Results for Robustness Checks."

B.6 Benchmark is $1/N$-buy-and-hold rather than $1/N$-with rebalancing

The results reported in the paper compare the strategies from the various models of optimal portfolio choice to the $1/N$ policy in which each period the $1/N$ portfolio is rebalanced to ensure that, given the change in prices of assets, the relative weights are still $1/N$. One could also consider a different benchmark in which investors have inertia and *do not rebalance* even the naive $1/N$ portfolio after the initial date on which the position is established.[3] We find that the results reported are similar to the case in which one uses as the benchmark portfolio the $1/N$-buy-and-hold portfolio, and there is virtually no change in the ranking of the $1/N$ policy relative to the strategies from the optimizing models.

B.7 Different levels of risk aversion

For all the asset allocation policies considered, we have reported results for only the case in which risk aversion is equal to 1. We considered also the following levels of risk aversion: $\gamma = \{2, 3, 4, 5, 10\}$. We find that the results are not very different across risk aversion levels. In particular, the Sharpe ratios for the unconstrained policies are not affected at all by the level of risk aversion, which is a consequence of two-fund separation (and because we are looking at the performance of the fund of just risky assets). The level of risk aversion affects the Sharpe ratio of only the mean-variance-constrained policy ("min-c") and the Bayes-Stein-constrained policy ("bs-c") for which two-fund separation does not hold because the level of risk aversion determines whether the constraints will be binding or not. So, a change in risk aversion has almost no effect on the rank of the $1/N$ strategy evaluated in terms of Sharpe ratios. The only quantity influenced significantly by risk aversion is the CEQ return. Because there is no optimization in the $1/N$ rule, as risk aversion increases the rank of the $1/N$ strategy in terms of CEQ returns drops: for γ equal to 1 and 2, the $1/N$ strategy ranks second; for γ equal to 3, it ranks third; for γ equal to 4, it ranks sixth; and, for γ equal to 5 and 10, it ranks seventh.

B.8 Different levels of confidence in the asset-pricing model

In the Bayesian Data-and-Model ("dm") approach developed in Pástor (2000) and Pástor and Stambaugh (2000), the investor forms a prior based on her subjective belief in a particular asset-pricing model. In the results that we report in the paper, the tightness of the subjective prior belief in the asset-pricing model is assumed to be $\sigma_\alpha = 1\%$ per annum. We also consider the values of $\sigma_\alpha = \{0.5\%, 2\%\}$ and find that although a change in σ_α has an effect on the Sharpe ratio, CEQ return, and turnover, the *relative* performance of the Data-and-Model strategy is not very sensitive to the choices of σ_α considered. An interesting finding is that for the "FF-4-factor" dataset of twenty size- and book-to-market portfolios, the "dm" strategy with the investor having a prior on the Carhart (1997) model performs better than the $1/N$ strategy if $\sigma_\alpha = 1\%$, though the difference in performance is not statistically significant. However, if a tighter prior of $\sigma_\alpha = 0.5\%$ is imposed, then the Sharpe ratio of the "dm" strategy is significantly superior to that of the $1/N$ strategy. This is because Carhart's (1997) model provides a good description of the cross-sectional returns of size- and book-to-market portfolios, and so placing a strong prior on it allows one to exploit fully its forecasting ability.

[3] There is evidence that investors often take the "path of least resistance" and exhibit inertia when making investment and rebalancing decisions. For instance, in allocating their wealth in pension schemes, employees often accept the default asset allocation offered by employers (Madrian and Shea (2000) and Choi, Laibson, Madrian, and Metrick (2001)), and many employees never rebalance these initial allocations (Agnew, Balduzzi, and Sunden (2003) and Choi, Laibson, Madrian, and Metrick (2004)).

C Tables for robustness-check experiments

C.0 Table for benchmark case reported in manuscript

Table 1: Sharpe Ratios

`RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal`

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 1.0\%$)	0.1410	0.0581	0.0707	0.0016	0.0004	0.2355
	(0.08)	(0.14)	(0.08)	(0.00)	(0.01)	(0.17)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.0892	0.0678	0.0848	0.1084	0.1977	0.2024
	(0.09)	(0.03)	(0.17)	(0.02)	(0.02)	(0.27)
bs-c	0.1075	0.0819	0.0848	0.1514	0.1955	0.2062
	(0.14)	(0.06)	(0.15)	(0.09)	(0.03)	(0.25)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 2: CEQ Returns

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0069	0.0050	0.0046	0.0039	0.0073	0.0072
mv (in sample)	0.0478	0.0106	0.0096	0.0047	0.0300	0.0304
mv	0.0031	-0.7816	-0.1365	0.0045	-2.7142	-0.0829
	(0.28)	(0.00)	(0.00)	(0.31)	(0.00)	(0.01)
bs	0.0030	-0.3157	-0.0312	0.0043	-0.6504	-0.0362
	(0.16)	(0.00)	(0.00)	(0.32)	(0.00)	(0.06)
dm ($\sigma_\alpha = 1.0\%$)	0.0052	-0.0319	0.0021	-0.0084	-0.0296	0.0110
	(0.11)	(0.01)	(0.08)	(0.04)	(0.00)	(0.11)
min	0.0024	0.0052	0.0054	0.0039	0.0100	-0.0002
	(0.03)	(0.45)	(0.23)	(0.45)	(0.12)	(0.00)
vw	0.0053	0.0042	0.0044	0.0042	0.0042	0.0042
	(0.12)	(0.04)	(0.39)	(0.44)	(0.00)	(0.00)
mp	0.0073	0.0014	0.0034	-0.0026	0.0054	0.0053
	(0.19)	(0.05)	(0.17)	(0.04)	(0.09)	(0.10)
mv-c	0.0040	0.0023	0.0032	0.0030	0.0090	0.0075
	(0.29)	(0.10)	(0.29)	(0.28)	(0.03)	(0.42)
bs-c	0.0052	0.0031	0.0031	0.0038	0.0088	0.0074
	(0.36)	(0.15)	(0.23)	(0.46)	(0.05)	(0.44)
min-c	0.0024	0.0047	0.0054	0.0039	0.0060	0.0051
	(0.01)	(0.40)	(0.21)	(0.45)	(0.12)	(0.17)
g-min-c	0.0044	0.0048	0.0051	0.0038	0.0067	0.0070
	(0.04)	(0.41)	(0.28)	(0.40)	(0.17)	(0.45)
mv-min	0.0021	-0.2337	-0.0066	0.0044	-0.0875	-0.0318
	(0.07)	(0.00)	(0.01)	(0.28)	(0.00)	(0.07)
ew-min	0.0037	0.0052	0.0050	0.0039	0.0093	-0.0002
	(0.04)	(0.42)	(0.24)	(0.43)	(0.12)	(0.00)

Table 3: Turnover

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF-1-factor $N = 21$	FF-4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 1.0\%$)	1.72	21744.35	60.97	76.30	918.40	32.46
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	4.53	7.17	7.23	4.12	17.53	13.82
bs-c	3.64	7.22	6.10	3.65	17.32	13.07
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	−0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 1.0\%$)	0.0021	8.9987	0.0130	0.0393	0.1302	−0.0007
min	0.0048	0.0015	0.0000	−0.0004	−0.0008	0.0024
vw	−0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0085	0.0048	0.0034	0.0041	−0.0005	0.0002
bs-c	0.0061	0.0038	0.0030	0.0023	−0.0004	−0.0000
min-c	0.0042	−0.0001	−0.0007	−0.0004	0.0006	−0.0025
g-min-c	0.0019	−0.0003	−0.0006	−0.0003	0.0001	−0.0029
mv-min	0.0085	6.8115	0.1706	−0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	−0.0001	−0.0004	−0.0011	0.0024

Table 4: Ranking

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	8	6	10	38	6
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	11	13	9	12	7	65	14
bs	12	10	12	3	11	8	56	10
dm ($\sigma_\alpha = 1.0\%$)	5	13	11	13	13	4	59	12
min	11	3	3	5	2	14	38	5
vw	4	7	7	11	10	12	51	8
mp	3	14	8	14	9	11	59	11
mv-c	9	12	9	12	4	6	52	9
bs-c	8	8	10	10	5	5	46	7
min-c	10	5	2	6	8	2	33	3
g-min-c	6	4	4	7	7	3	31	2
mv-min	14	9	14	2	14	9	62	13
ew-min	7	2	5	4	3	13	34	4
Panel B: Rank based on CEQ								
$1/N$	3	4	6	6	6	5	30	2
mv (in sample)	1	1	1	1	1	1	6	1
mv	10	14	14	2	14	14	68	14
bs	11	13	13	4	13	13	67	13
dm ($\sigma_\alpha = 0.01$)	5	11	11	14	11	2	54	11
min	13	3	2	8	2	11	39	4
vw	4	7	7	5	10	9	42	6
mp	2	10	8	13	9	7	49	10
mv-c	8	9	9	12	4	3	45	9
bs-c	6	8	10	10	5	4	43	7
min-c	12	6	3	7	8	8	44	8
g-min-c	7	5	4	11	7	6	40	5
mv-min	14	12	12	3	12	12	65	12
ew-min	9	2	5	9	3	10	38	3
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	9	12	12	72	13
bs	12	11	12	7	13	11	66	12
dm ($\sigma_\alpha = 1.0\%$)	5	12	10	13	10	10	60	10
min	10	9	9	5	9	7	49	9
vw	1	1	1	1	1	1	6	1
mp	3	7	7	12	4	5	38	5
mv-c	8	5	8	11	7	9	48	8
bs-c	7	6	6	10	6	8	43	7
min-c	6	4	4	4	5	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	8	11	13	64	11
ew-min	9	8	5	6	8	6	42	6

C.1 Tables for different estimation window length ($M = 60$)

Table 5: Sharpe Ratios

RO_M60_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0070	0.0564	-0.1013	-0.0186	-0.0537	0.0701
	(0.04)	(0.13)	(0.00)	(0.00)	(0.00)	(0.08)
bs	0.0299	0.0663	-0.0998	0.0016	-0.0483	0.0642
	(0.04)	(0.16)	(0.00)	(0.00)	(0.00)	(0.07)
dm ($\sigma_\alpha = 1.0\%$)	0.1510	0.0014	0.1032	0.0514	0.0296	-0.0117
	(0.28)	(0.01)	(0.27)	(0.01)	(0.01)	(0.01)
min	0.1267	0.1402	0.1316	0.2376	0.2326	-0.0261
	(0.18)	(0.46)	(0.45)	(0.34)	(0.09)	(0.00)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1509	0.0688	0.0847	0.0608	0.0965	0.0960
	(0.12)	(0.11)	(0.11)	(0.01)	(0.08)	(0.05)
mv-c	0.0899	0.0991	0.0719	0.1733	0.2051	0.1443
	(0.10)	(0.17)	(0.10)	(0.17)	(0.07)	(0.27)
bs-c	0.1101	0.0903	0.0678	0.1714	0.1981	0.1580
	(0.12)	(0.12)	(0.07)	(0.15)	(0.08)	(0.36)
min-c	0.1004	0.1441	0.1306	0.2376	0.1541	0.3470
	(0.02)	(0.38)	(0.45)	(0.34)	(0.34)	(0.00)
g-min-c	0.1447	0.1400	0.1304	0.2422	0.1585	0.3008
	(0.08)	(0.40)	(0.44)	(0.29)	(0.38)	(0.00)
mv-min	0.0487	0.0906	0.0283	-0.0003	-0.0328	0.0470
	(0.03)	(0.26)	(0.12)	(0.00)	(0.00)	(0.05)
ew-min	0.1578	0.1532	0.1388	0.2407	0.2283	-0.0248
	(0.28)	(0.31)	(0.31)	(0.28)	(0.07)	(0.00)

Table 6: CEQ Returns

RO_M60_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0069	0.0050	0.0046	0.0039	0.0073	0.0072
mv (in sample)	0.0478	0.0106	0.0096	0.0047	0.0300	0.0304
mv	-0.0101	-1.2805	-0.3236	-0.0171	-0.9358	-0.0440
	(0.08)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
bs	-0.0009	-0.3462	-0.0643	-0.0029	-0.2680	-0.0125
	(0.11)	(0.00)	(0.00)	(0.04)	(0.00)	(0.06)
dm ($\sigma_\alpha = 1.0\%$)	0.0057	-0.0028	0.0035	-0.0000	-0.0002	-0.0229
	(0.32)	(0.02)	(0.26)	(0.23)	(0.02)	(0.00)
min	0.0040	0.0048	0.0047	0.0038	0.0089	-0.0003
	(0.14)	(0.46)	(0.47)	(0.37)	(0.26)	(0.00)
vw	0.0053	0.0042	0.0044	0.0042	0.0042	0.0042
	(0.12)	(0.04)	(0.39)	(0.44)	(0.00)	(0.00)
mp	0.0059	0.0021	0.0028	0.0017	0.0039	0.0038
	(0.22)	(0.12)	(0.12)	(0.29)	(0.09)	(0.09)
mv-c	0.0038	0.0041	0.0025	0.0054	0.0092	0.0058
	(0.26)	(0.34)	(0.19)	(0.18)	(0.11)	(0.28)
bs-c	0.0046	0.0035	0.0022	0.0050	0.0088	0.0059
	(0.26)	(0.22)	(0.11)	(0.23)	(0.12)	(0.28)
min-c	0.0031	0.0047	0.0045	0.0038	0.0061	0.0049
	(0.01)	(0.40)	(0.48)	(0.37)	(0.14)	(0.15)
g-min-c	0.0047	0.0046	0.0045	0.0038	0.0066	0.0068
	(0.04)	(0.33)	(0.44)	(0.38)	(0.16)	(0.41)
mv-min	0.0012	-0.1294	-0.0226	-0.0026	-0.0460	-0.0071
	(0.06)	(0.00)	(0.04)	(0.04)	(0.00)	(0.07)
ew-min	0.0052	0.0052	0.0049	0.0038	0.0084	-0.0003
	(0.19)	(0.45)	(0.36)	(0.38)	(0.29)	(0.00)

Table 7: Turnover

RO_M60_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	201.36	65631.53	10481.68	76.50	6587.29	3210.45
bs	168.83	23367.36	1555.36	293.89	3371.66	2003.32
dm ($\sigma_\alpha = 1.0\%$)	6.19	1129.57	32.76	109.99	863.64	328.13
min	11.41	50.74	17.14	1.46	99.80	11.02
vw	0	0	0	0	0	0
mp	1.74	20.85	7.59	78.89	15.16	13.62
mv-c	5.13	14.84	9.96	2.96	15.31	14.37
bs-c	5.56	13.20	9.93	4.73	16.63	14.33
min-c	3.83	4.27	3.92	1.46	8.05	2.49
g-min-c	2.12	2.22	2.25	1.30	3.66	1.98
mv-min	44.93	21243.81	2173.22	115.68	2242.06	1641.27
ew-min	8.58	40.04	11.71	1.42	83.20	11.00
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0530	23.9724	3.3174	0.0233	3.1313	0.6410
bs	0.0476	6.6494	0.2474	0.1736	0.7862	0.3219
dm ($\sigma_\alpha = 1.0\%$)	0.0024	0.2066	0.0059	0.0273	0.1829	0.0252
min	0.0039	0.0053	0.0022	-0.0002	0.0052	0.0031
vw	0.0015	0.0030	0.0018	0.0126	0.0036	0.0044
mp	0.0018	0.0053	0.0029	0.0219	0.0049	0.0058
mv-c	0.0073	0.0039	0.0045	0.0019	-0.0014	0.0028
bs-c	0.0050	0.0036	0.0045	0.0020	-0.0004	0.0021
min-c	0.0037	0.0000	0.0003	-0.0002	0.0010	-0.0023
g-min-c	0.0018	-0.0000	0.0001	-0.0002	0.0004	-0.0028
mv-min	0.0141	10.1366	0.2849	0.0612	0.3675	0.2540
ew-min	0.0023	0.0036	0.0011	-0.0002	0.0041	0.0031

Table 8: Ranking

RO_M60_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	6	6	4	30	4
mv (in sample)	1	1	1	1	1	1	6	1
mv	14	13	14	14	14	9	78	14
bs	13	12	13	12	13	10	73	13
dm ($\sigma_\alpha = 1.0\%$)	4	14	8	11	11	12	60	11
min	8	4	3	5	2	14	36	6
vw	7	7	7	9	9	7	46	8
mp	5	11	9	10	10	8	53	10
mv-c	11	8	10	7	4	6	46	7
bs-c	9	10	11	8	5	5	48	9
min-c	10	3	4	4	8	2	31	5
g-min-c	6	5	5	2	7	3	28	3
mv-min	12	9	12	13	12	11	69	12
ew-min	3	2	2	3	3	13	26	2
Panel B: Rank based on CEQ								
$1/N$	2	3	4	5	6	2	22	2
mv (in sample)	1	1	1	3	1	1	8	1
mv	14	14	14	14	14	14	84	14
bs	13	13	13	13	13	12	77	13
dm ($\sigma_\alpha = 0.01$)	4	11	8	11	11	13	58	11
min	9	4	3	9	3	10	38	7
vw	5	7	7	4	9	7	39	8
mp	3	10	9	10	10	8	50	10
mv-c	10	8	10	1	2	5	36	5
bs-c	8	9	11	2	4	4	38	6
min-c	11	5	5	8	8	6	43	9
g-min-c	7	6	6	7	7	3	36	4
mv-min	12	12	12	12	12	11	71	12
ew-min	6	2	2	6	5	9	30	3
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	9	13	13	74	13
bs	12	12	11	13	12	12	72	12
dm ($\sigma_\alpha = 1.0\%$)	8	10	10	11	10	10	59	10
min	10	9	9	5	9	6	48	9
vw	1	1	1	1	1	1	6	1
mp	3	7	5	10	5	7	37	5
mv-c	6	6	7	7	6	9	41	7
bs-c	7	5	6	8	7	8	41	6
min-c	5	4	4	6	4	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	11	12	12	11	11	68	11
ew-min	9	8	8	4	8	5	42	8

C.2 Tables for increasing estimation window rather than a rolling window

Table 9: Sharpe Ratios

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Increasing_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0451	-0.0308	-0.0970	0.2507	0.0892	0.0824
	(0.07)	(0.01)	(0.00)	(0.30)	(0.15)	(0.11)
bs	0.0550	-0.0259	-0.0958	0.2639	0.1113	0.0814
	(0.04)	(0.02)	(0.00)	(0.17)	(0.23)	(0.10)
dm ($\sigma_\alpha = 1.0\%$)	0.1392	0.0923	0.0132	0.0927	0.1897	0.4043
	(0.07)	(0.23)	(0.01)	(0.01)	(0.30)	(0.00)
min	0.0763	0.1538	0.1460	0.2669	0.2294	-0.0534
	(0.05)	(0.30)	(0.21)	(0.14)	(0.08)	(0.00)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1891	0.1136	0.1160	0.0767	0.1566	0.1555
	(0.42)	(0.23)	(0.10)	(0.00)	(0.00)	(0.00)
mv-c	0.2221	0.0831	0.0693	0.1820	0.2107	0.2364
	(0.31)	(0.06)	(0.12)	(0.25)	(0.00)	(0.07)
bs-c	0.2157	0.0985	0.1008	0.2458	0.1991	0.2625
	(0.34)	(0.10)	(0.28)	(0.34)	(0.01)	(0.04)
min-c	0.1144	0.1488	0.1500	0.2669	0.1298	0.3602
	(0.08)	(0.30)	(0.12)	(0.14)	(0.05)	(0.00)
g-min-c	0.1373	0.1466	0.1477	0.2648	0.1488	0.3120
	(0.11)	(0.26)	(0.09)	(0.15)	(0.08)	(0.00)
mv-min	0.0212	-0.0231	-0.0935	0.2389	0.0274	0.0751
	(0.01)	(0.02)	(0.00)	(0.33)	(0.01)	(0.09)
ew-min	0.1185	0.1570	0.1395	0.2703	0.2238	-0.0512
	(0.07)	(0.16)	(0.14)	(0.08)	(0.03)	(0.00)

Table 10: CEQ Returns

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Increasing_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0069	0.0050	0.0046	0.0039	0.0073	0.0072
mv (in sample)	0.0478	0.0106	0.0096	0.0047	0.0300	0.0304
mv	0.0009	-0.1654	-1.7130	0.0044	-0.0058	-0.7021
	(0.12)	(0.00)	(0.00)	(0.30)	(0.14)	(0.00)
bs	0.0015	-0.0654	-0.4918	0.0042	0.0062	-0.1808
	(0.05)	(0.00)	(0.00)	(0.35)	(0.43)	(0.00)
dm ($\sigma_\alpha = 1.0\%$)	0.0050	0.0041	-0.0006	0.0026	0.0090	0.0163
	(0.08)	(0.44)	(0.02)	(0.20)	(0.27)	(0.00)
min	0.0022	0.0052	0.0052	0.0042	0.0080	-0.0006
	(0.04)	(0.45)	(0.27)	(0.35)	(0.38)	(0.00)
vw	0.0053	0.0042	0.0044	0.0042	0.0042	0.0042
	(0.12)	(0.04)	(0.39)	(0.44)	(0.00)	(0.00)
mp	0.0074	0.0041	0.0042	0.0026	0.0071	0.0070
	(0.14)	(0.26)	(0.14)	(0.26)	(0.11)	(0.38)
mv-c	0.0086	0.0030	0.0024	0.0039	0.0103	0.0086
	(0.28)	(0.12)	(0.23)	(0.48)	(0.00)	(0.22)
bs-c	0.0082	0.0037	0.0043	0.0045	0.0090	0.0086
	(0.33)	(0.18)	(0.45)	(0.30)	(0.01)	(0.24)
min-c	0.0037	0.0050	0.0053	0.0042	0.0049	0.0053
	(0.06)	(0.49)	(0.19)	(0.35)	(0.01)	(0.20)
g-min-c	0.0046	0.0050	0.0052	0.0041	0.0061	0.0071
	(0.08)	(0.49)	(0.16)	(0.38)	(0.01)	(0.48)
mv-min	-0.0001	-0.0446	-0.1735	0.0039	-0.0006	-0.0252
	(0.01)	(0.00)	(0.00)	(0.45)	(0.02)	(0.03)
ew-min	0.0037	0.0052	0.0050	0.0042	0.0078	-0.0006
	(0.04)	(0.39)	(0.23)	(0.34)	(0.38)	(0.00)

Table 11: Turnover

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Increasing_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	17.82	3248.36	12800.50	1.24	1186.11	2153.71
bs	9.34	1575.08	3807.31	0.96	7520.32	1038.82
dm ($\sigma_\alpha = 1.0\%$)	1.59	598.75	530.91	2.91	127.39	22.66
min	4.33	8.35	2.46	0.95	18.96	4.70
vw	0	0	0	0	0	0
mp	1.03	1.95	2.05	3.00	1.03	0.89
mv-c	0.27	5.37	1.06	2.69	6.18	4.83
bs-c	0.42	4.08	1.78	1.67	8.74	3.61
min-c	1.35	1.44	1.14	0.95	0.64	1.36
g-min-c	0.98	1.29	1.02	0.93	0.89	1.51
mv-min	8.42	1272.04	2096.02	1.30	107.44	510.29
ew-min	3.05	5.47	1.61	0.98	11.76	4.68
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0114	2.3613	6.0051	-0.0005	0.1051	1.9729
bs	0.0071	0.8562	1.2373	-0.0007	0.2905	0.5505
dm ($\sigma_\alpha = 1.0\%$)	0.0021	0.1616	0.1843	0.0047	0.0122	-0.0076
min	0.0049	0.0001	-0.0005	-0.0007	-0.0010	0.0028
vw	-0.0002	0.0009	0.0004	0.0070	0.0002	0.0010
mp	-0.0001	0.0011	0.0007	0.0074	0.0003	0.0011
mv-c	-0.0016	0.0033	0.0038	0.0011	-0.0023	-0.0020
bs-c	-0.0013	0.0022	0.0017	-0.0003	-0.0013	-0.0028
min-c	0.0029	-0.0005	-0.0009	-0.0007	0.0015	-0.0027
g-min-c	0.0020	-0.0004	-0.0008	-0.0007	0.0007	-0.0031
mv-min	0.0088	0.5482	0.3085	-0.0002	0.0190	0.1146
ew-min	0.0029	-0.0003	-0.0004	-0.0007	-0.0014	0.0028

Table 12: Ranking

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Increasing_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	5	6	6	10	7	7	41	7
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	14	14	7	13	10	71	13
bs	12	13	13	6	12	11	67	12
dm ($\sigma_\alpha = 1.0\%$)	7	10	11	13	6	2	49	9
min	11	3	4	3	2	14	37	5
vw	6	7	7	12	11	9	52	11
mp	4	8	8	14	8	8	50	10
mv-c	2	11	10	11	4	6	44	8
bs-c	3	9	9	8	5	5	39	6
min-c	10	4	2	4	10	3	33	2
g-min-c	8	5	3	5	9	4	34	4
mv-min	14	12	12	9	14	12	73	14
ew-min	9	2	5	2	3	13	34	3
Panel B: Rank based on CEQ								
$1/N$	5	4	6	10	7	5	37	3
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	14	14	3	14	14	72	13
bs	12	13	13	5	9	13	65	12
dm ($\sigma_\alpha = 0.01$)	7	8	11	13	4	2	45	9
min	11	3	4	7	5	11	41	7
vw	6	7	7	4	12	9	45	10
mp	4	9	9	14	8	7	51	11
mv-c	2	11	10	11	2	4	40	5
bs-c	3	10	8	2	3	3	29	2
min-c	10	6	2	6	11	8	43	8
g-min-c	8	5	3	9	10	6	41	6
mv-min	14	12	12	12	13	12	75	14
ew-min	9	2	5	8	6	10	40	4
Panel C: Rank based on Turnover								
$1/N$	5	2	2	7	4	3	23	3
mv	13	13	13	8	12	13	72	13
bs	12	12	12	5	13	12	66	12
dm ($\sigma_\alpha = 1.0\%$)	8	10	10	12	11	10	61	10
min	10	9	9	4	9	8	49	9
vw	1	1	1	1	1	1	6	1
mp	6	5	8	13	5	2	39	5
mv-c	2	7	4	11	6	9	39	7
bs-c	3	6	7	10	7	6	39	6
min-c	7	4	5	3	2	4	25	4
g-min-c	4	3	3	2	3	5	20	2
mv-min	11	11	11	9	10	11	63	11
ew-min	9	8	6	6	8	7	44	8

C.3 Tables for different holding period (12 months, instead of 1 month)

Table 13: Sharpe Ratios

RO_M120_gamma1_sigAlpha0.010_hp12_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.7427	0.4522	0.3649	0.7742	0.5641	0.6067
mv (in sample)	1.3330	0.7358	0.7241	0.9875	1.7661	1.8583
mv	0.3527	-0.0546	-0.1980	0.8632	0.4212	0.6366
	(0.00)	(0.00)	(0.00)	(0.11)	(0.02)	(0.35)
bs	0.3597	0.0670	-0.1566	0.9777	0.4613	0.6382
	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.34)
dm ($\sigma_\alpha = 1.0\%$)	0.4416	-0.0927	0.2185	0.3571	0.2219	0.9486
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
min	0.2699	0.5059	0.4835	0.7205	0.7061	-0.0342
	(0.00)	(0.12)	(0.00)	(0.11)	(0.01)	(0.00)
vw	0.4423	0.3864	0.4117	0.3864	0.3864	0.3864
	(0.00)	(0.00)	(0.12)	(0.00)	(0.00)	(0.00)
mp	0.7606	0.1774	0.2830	-0.0025	0.5354	0.5337
	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
mv-c	0.2253	0.2217	0.2891	0.3666	0.6232	0.8983
	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)
bs-c	0.3023	0.2374	0.3535	0.4828	0.6048	0.8993
	(0.00)	(0.00)	(0.40)	(0.00)	(0.03)	(0.00)
min-c	0.3111	0.4583	0.4770	0.7205	0.5323	1.0842
	(0.00)	(0.41)	(0.00)	(0.11)	(0.10)	(0.00)
g-min-c	0.4676	0.4692	0.4496	0.7155	0.5530	0.9583
	(0.00)	(0.18)	(0.00)	(0.09)	(0.19)	(0.00)
mv-min	0.3383	0.3313	-0.1282	1.0531	0.5109	0.6323
	(0.00)	(0.03)	(0.00)	(0.00)	(0.23)	(0.37)
ew-min	0.4297	0.5253	0.4289	0.7542	0.7216	-0.0271
	(0.00)	(0.01)	(0.00)	(0.30)	(0.00)	(0.00)

Table 14: CEQ Returns

RO_M120_gamma1_sigAlpha0.010_hp12_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0907	0.0618	0.0539	0.0503	0.0902	0.0889
mv (in sample)	0.5738	0.1270	0.1158	0.0559	0.3599	0.3643
mv	0.0483	-0.3712	-1.1184	0.0602	-1.7714	0.0803
	(0.17)	(0.00)	(0.00)	(0.25)	(0.01)	(0.49)
bs	0.0411	-0.0519	-0.4477	0.0593	-0.2891	0.1803
	(0.04)	(0.06)	(0.01)	(0.18)	(0.12)	(0.30)
dm ($\sigma_\alpha = 1.0\%$)	0.0651	-0.0998	0.0229	0.0334	0.0198	0.1345
	(0.15)	(0.01)	(0.12)	(0.23)	(0.15)	(0.10)
min	0.0259	0.0581	0.0738	0.0507	0.1242	-0.0017
	(0.00)	(0.43)	(0.03)	(0.48)	(0.17)	(0.00)
vw	0.0643	0.0497	0.0516	0.0497	0.0497	0.0497
	(0.13)	(0.01)	(0.45)	(0.49)	(0.01)	(0.01)
mp	0.0956	0.0157	0.0378	-0.0328	0.0864	0.0857
	(0.13)	(0.11)	(0.08)	(0.05)	(0.07)	(0.30)
mv-c	0.0249	0.0242	0.0416	0.0387	0.1153	0.1141
	(0.11)	(0.12)	(0.37)	(0.33)	(0.05)	(0.13)
bs-c	0.0421	0.0280	0.0566	0.0446	0.1113	0.1112
	(0.09)	(0.09)	(0.47)	(0.40)	(0.09)	(0.15)
min-c	0.0357	0.0561	0.0714	0.0507	0.0752	0.0664
	(0.01)	(0.35)	(0.04)	(0.48)	(0.15)	(0.22)
g-min-c	0.0595	0.0600	0.0652	0.0501	0.0824	0.0880
	(0.06)	(0.43)	(0.12)	(0.49)	(0.16)	(0.48)
mv-min	0.0361	0.0526	-0.3281	0.0628	0.0788	0.1862
	(0.01)	(0.43)	(0.01)	(0.08)	(0.47)	(0.27)
ew-min	0.0455	0.0604	0.0643	0.0508	0.1168	-0.0014
	(0.00)	(0.47)	(0.04)	(0.47)	(0.17)	(0.00)

Table 15: Turnover

RO_M120_gamma1_sigAlpha0.010_hp12_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0028	0.0018	0.0028	0.0020	0.0013	0.0016
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	21.89	5858.70	5067.80	2.32	4819.09	5523.56
bs	12.30	4125.49	1793.44	1.58	3384.32	3999.95
dm ($\sigma_\alpha = 1.0\%$)	1.27	3428.25	16.30	7.44	1084.51	23.17
min	5.70	17.95	7.10	0.96	43.64	7.43
vw	0	0	0	0	0	0
mp	1.02	13.03	6.58	67.11	1.09	0.98
mv-c	3.73	8.92	5.36	2.79	22.96	14.95
bs-c	3.37	7.87	NaN	1.94	24.05	15.07
min-c	1.80	2.23	1.87	0.96	2.72	1.45
g-min-c	1.06	1.47	1.23	0.97	1.45	1.52
mv-min	9.90	3816.02	450.33	1.94	19635.32	3668.09
ew-min	4.08	12.97	4.16	0.97	32.72	7.40
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0760	2.2518	1.5886	-0.0064	2.8254	6.9448
bs	0.0565	1.7980	0.8570	-0.0127	0.8723	3.6253
dm ($\sigma_\alpha = 1.0\%$)	0.0562	0.9032	0.0274	0.0469	0.1747	-0.0520
min	0.0600	-0.0056	-0.0215	0.0040	-0.0260	0.0216
vw	-0.0027	0.0518	0.0175	0.1965	0.0056	0.0143
mp	-0.0025	0.0525	0.0182	0.2007	0.0057	0.0144
mv-c	0.1327	0.0580	0.0210	0.0522	-0.0120	-0.0385
bs-c	0.0961	0.0474	0.0009	0.0302	-0.0080	-0.0374
min-c	0.0656	-0.0008	-0.0207	0.0040	0.0055	-0.0300
g-min-c	0.0418	-0.0026	-0.0153	0.0043	0.0020	-0.0339
mv-min	0.0552	1.7064	0.4242	-0.0170	21.8483	2.9245
ew-min	0.0393	-0.0086	-0.0118	0.0014	-0.0267	0.0212

Table 16: Ranking

RO_M120_gamma1_sigAlpha0.010_hp12_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	3	6	7	5	6	10	37	4
mv (in sample)	1	1	1	2	1	1	7	1
mv	9	13	14	4	12	8	60	13
bs	8	12	13	3	11	7	54	9
dm ($\sigma_\alpha = 1.0\%$)	6	14	11	13	14	4	62	14
min	13	3	2	7	3	14	42	6
vw	5	7	6	11	13	12	54	10
mp	2	11	10	14	8	11	56	12
mv-c	14	10	9	12	4	6	55	11
bs-c	12	9	8	10	5	5	49	7
min-c	11	5	3	8	9	2	38	5
g-min-c	4	4	4	9	7	3	31	2
mv-min	10	8	12	1	10	9	50	8
ew-min	7	2	5	6	2	13	35	3
Panel B: Rank based on CEQ								
$1/N$	3	2	7	8	6	7	33	2
mv (in sample)	1	1	1	4	1	1	9	1
mv	7	14	14	2	14	10	61	14
bs	10	12	13	3	13	3	54	10
dm ($\sigma_\alpha = 0.01$)	4	13	11	13	12	4	57	13
min	13	5	2	7	2	14	43	6
vw	5	8	8	10	11	12	54	12
mp	2	11	10	14	7	9	53	9
mv-c	14	10	9	12	4	5	54	11
bs-c	9	9	6	11	5	6	46	7
min-c	12	6	3	6	10	11	48	8
g-min-c	6	4	4	9	8	8	39	4
mv-min	11	7	12	1	9	2	42	5
ew-min	8	3	5	5	3	13	37	3
Panel C: Rank based on Turnover								
$1/N$	2	2	2	6	2	3	17	2
mv	13	13	12	10	12	13	73	13
bs	12	12	11	7	11	12	65	12
dm ($\sigma_\alpha = 1.0\%$)	5	10	9	12	10	10	56	10
min	10	9	8	2	9	7	45	7
vw	1	1	1	1	1	1	6	1
mp	3	8	7	13	3	2	36	5
mv-c	8	6	6	11	6	8	45	8
bs-c	7	5	13	9	7	9	50	9
min-c	6	4	4	3	5	4	26	4
g-min-c	4	3	3	4	4	5	23	3
mv-min	11	11	10	8	13	11	64	11
ew-min	9	7	5	5	8	6	40	6

C.4 Tables for portfolios that include the riskfree asset

Table 17: Sharpe Ratios

`All_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal`

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0979	0.0274	-0.0027	0.1966	0.3678	0.4058
	(0.16)	(0.04)	(0.02)	(0.30)	(0.00)	(0.00)
bs	0.0975	0.0562	0.0256	0.2212	0.3797	0.3969
	(0.13)	(0.09)	(0.02)	(0.47)	(0.00)	(0.00)
dm ($\sigma_\alpha = 1.0\%$)	0.1031	0.0633	0.0770	0.0847	0.1475	0.3531
	(0.04)	(0.05)	(0.10)	(0.01)	(0.38)	(0.00)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1322	0.0765	0.0869	0.0522	0.0838	0.0812
	(0.02)	(0.07)	(0.08)	(0.00)	(0.01)	(0.00)
mv-c	0.0892	0.0628	0.0760	0.1084	0.1976	0.2024
	(0.09)	(0.02)	(0.13)	(0.02)	(0.02)	(0.27)
bs-c	0.1075	0.0686	0.0903	0.1514	0.1875	0.2062
	(0.14)	(0.03)	(0.18)	(0.09)	(0.11)	(0.25)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0813	0.0762	0.0311	0.2274	0.3784	0.3843
	(0.08)	(0.15)	(0.02)	(0.47)	(0.00)	(0.00)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 18: CEQ Returns

All_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0064	0.0046	0.0042	0.0030	0.0070	0.0069
mv (in sample)	0.0740	0.0226	0.0218	0.0406	0.1300	0.1439
mv	-0.0837	-0.0760	-0.0384	0.0134	-0.1026	-0.1133
	(0.02)	(0.00)	(0.00)	(0.25)	(0.03)	(0.03)
bs	-0.0293	-0.0237	-0.0148	0.0237	-0.0007	0.0016
	(0.11)	(0.02)	(0.04)	(0.06)	(0.43)	(0.45)
dm ($\sigma_\alpha = 1.0\%$)	-0.0047	-0.0025	0.0011	0.0006	0.0107	0.0545
	(0.27)	(0.16)	(0.32)	(0.38)	(0.31)	(0.03)
min	0.0024	0.0052	0.0054	0.0039	0.0100	-0.0002
	(0.04)	(0.36)	(0.13)	(0.04)	(0.09)	(0.00)
vw	0.0053	0.0042	0.0044	0.0042	0.0042	0.0042
	(0.22)	(0.21)	(0.45)	(0.26)	(0.00)	(0.01)
mp	0.0020	-0.0020	0.0021	-0.0006	0.0011	0.0008
	(0.40)	(0.20)	(0.38)	(0.27)	(0.16)	(0.16)
mv-c	0.0040	0.0020	0.0027	0.0030	0.0089	0.0075
	(0.33)	(0.10)	(0.27)	(0.49)	(0.02)	(0.37)
bs-c	0.0052	0.0023	0.0033	0.0038	0.0075	0.0074
	(0.40)	(0.10)	(0.33)	(0.26)	(0.30)	(0.39)
min-c	0.0024	0.0047	0.0054	0.0039	0.0060	0.0051
	(0.01)	(0.50)	(0.11)	(0.04)	(0.16)	(0.19)
g-min-c	0.0044	0.0048	0.0051	0.0038	0.0067	0.0070
	(0.06)	(0.42)	(0.13)	(0.05)	(0.28)	(0.48)
mv-min	-0.0169	-0.0072	-0.0100	0.0254	0.0504	0.0526
	(0.15)	(0.13)	(0.07)	(0.04)	(0.09)	(0.08)
ew-min	0.0037	0.0052	0.0050	0.0039	0.0093	-0.0002
	(0.05)	(0.30)	(0.09)	(0.02)	(0.08)	(0.00)

Table 19: Turnover

`All_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal`

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0227	0.0295	0.0205	0.0173	0.0206
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	1612.41	8981.07	774.72	1088.63	25406.46	15061.25
bs	773.64	4594.25	505.04	3709.66	10521.46	12643.66
dm ($\sigma_\alpha = 1.0\%$)	83.76	96.58	62.03	91.12	327.45	1805.50
min	6.54	20.59	7.26	1.28	42.71	6.57
vw	0	0	0	0	0	0
mp	77.17	87.72	35.03	63.80	97.65	169.99
mv-c	4.52	7.30	7.26	4.76	16.63	13.28
bs-c	3.63	7.91	6.25	4.22	16.58	12.56
min-c	2.47	2.45	2.26	1.28	3.69	1.69
g-min-c	1.30	1.44	1.47	1.26	1.67	1.63
mv-min	301.59	1202.67	631.09	641.08	3987.91	6147.67
ew-min	4.81	14.90	4.21	1.29	32.03	6.54
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.1310	0.4774	0.1049	0.0369	0.7445	0.8515
bs	0.0929	0.1944	0.0487	0.0410	0.3540	0.5838
dm ($\sigma_\alpha = 1.0\%$)	0.0270	0.0192	0.0107	0.0264	0.0138	0.0372
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	0.0013	0.0010	0.0005	0.0019	0.0012	0.0014
mp	0.0199	0.0142	0.0091	0.0214	0.0151	0.0190
mv-c	0.0084	0.0051	0.0038	0.0041	-0.0005	0.0002
bs-c	0.0061	0.0045	0.0027	0.0022	0.0002	-0.0000
min-c	0.0041	-0.0001	-0.0008	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0004	0.0001	-0.0029
mv-min	0.0687	0.1297	0.0439	0.0253	0.1875	0.3121
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 20: Ranking

`All_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal`

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	7	9	10	40	5
mv (in sample)	1	1	1	1	1	1	6	1
mv	9	14	14	9	4	2	52	10
bs	10	13	13	8	2	3	49	8
dm ($\sigma_\alpha = 1.0\%$)	8	11	10	13	12	6	60	12
min	13	3	3	3	5	14	41	6
vw	3	7	7	11	13	11	52	11
mp	5	8	9	14	14	12	62	13
mv-c	11	12	11	12	7	9	62	14
bs-c	7	10	8	10	8	8	51	9
min-c	12	5	2	4	11	5	39	4
g-min-c	4	4	4	5	10	7	34	3
mv-min	14	9	12	6	3	4	48	7
ew-min	6	2	5	2	6	13	34	2
Panel B: Rank based on CEQ								
$1/N$	2	6	7	12	8	7	42	8
mv (in sample)	1	1	1	1	1	1	6	1
mv	14	14	14	4	14	14	74	14
bs	13	13	13	3	13	10	65	12
dm ($\sigma_\alpha = 0.01$)	11	11	11	13	3	2	51	11
min	9	3	2	7	4	13	38	3
vw	3	7	6	5	11	9	41	7
mp	10	10	10	14	12	11	67	13
mv-c	6	9	9	11	6	4	45	10
bs-c	4	8	8	9	7	5	41	6
min-c	8	5	3	6	10	8	40	5
g-min-c	5	4	4	10	9	6	38	2
mv-min	12	12	12	2	2	3	43	9
ew-min	7	2	5	8	5	12	39	4
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	12	13	13	77	13
bs	12	12	11	13	12	12	72	12
dm ($\sigma_\alpha = 1.0\%$)	10	10	10	10	10	10	60	10
min	8	8	8	5	8	6	43	8
vw	1	1	1	1	1	1	6	1
mp	9	9	9	9	9	9	54	9
mv-c	6	5	7	8	6	8	40	7
bs-c	5	6	6	7	5	7	36	5
min-c	4	4	4	4	4	4	24	4
g-min-c	3	3	3	3	3	3	18	3
mv-min	11	11	12	11	11	11	67	11
ew-min	7	7	5	6	7	5	37	6

C.5 Tables for portfolios that exclude the factors as investable assets

Table 21: Sharpe Ratios

`RO_M120_gamma1_sigAlphaNaN_hp1_NonInvestableFactors_Rolling_ewRebal`

Strategy	S&P Sectors $N = 10$	Industry Portf. $N = 10$	Inter'l Portf. $N = 8$	Mkt/ SMB/HML $N = 2$	FF 1-factor $N = 20$	FF 4-factor $N = 20$
$1/N$	0.1906	0.1374	0.1271	0.1810	0.1637	0.1637
mv (in sample)	0.3302	0.1972	0.1928	0.1974	0.5097	0.5097
mv	0.0982	-0.0776	0.0325	0.0680	0.0000	0.0000
	(0.16)	(0.00)	(0.12)	(0.06)	(0.01)	(0.01)
bs	0.1084	-0.0346	0.0292	0.0914	0.0011	0.0011
	(0.15)	(0.00)	(0.09)	(0.09)	(0.01)	(0.01)
min	0.1062	0.1368	0.1520	0.1785	0.3216	0.3216
	(0.08)	(0.49)	(0.19)	(0.39)	(0.00)	(0.00)
mp	0.1898	0.0660	0.1003	0.0281	0.1193	0.1193
	(0.47)	(0.06)	(0.17)	(0.02)	(0.04)	(0.04)
mv-c	0.0889	0.0676	0.0847	0.1190	0.1932	0.1932
	(0.09)	(0.03)	(0.18)	(0.09)	(0.04)	(0.04)
bs-c	0.1111	0.0656	0.0860	0.1511	0.1897	0.1897
	(0.15)	(0.02)	(0.16)	(0.24)	(0.06)	(0.06)
min-c	0.0913	0.1425	0.1499	0.1785	0.2056	0.2056
	(0.02)	(0.43)	(0.17)	(0.39)	(0.01)	(0.01)
g-min-c	0.1379	0.1456	0.1442	0.1785	0.1830	0.1830
	(0.06)	(0.34)	(0.18)	(0.39)	(0.04)	(0.04)
mv-min	0.0999	0.1038	-0.0578	0.0842	-0.0032	-0.0032
	(0.10)	(0.30)	(0.02)	(0.08)	(0.01)	(0.01)
ew-min	0.1378	0.1442	0.1439	0.1819	0.2876	0.2876
	(0.11)	(0.40)	(0.16)	(0.41)	(0.00)	(0.00)

Table 22: CEQ Returns

RO_M120_gamma1_sigAlphaNaN_hp1_NonInvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 10$	Industry Portf. $N = 10$	Inter'l Portf. $N = 8$	Mkt/ SMB/HML $N = 2$	FF 1-factor $N = 20$	FF 4-factor $N = 20$
$1/N$	0.0071	0.0051	0.0046	0.0033	0.0074	0.0074
mv (in sample)	0.0223	0.0089	0.0082	0.0039	0.0314	0.0314
mv	0.0047	-0.0267	-0.1935	-0.0252	-13.4959	-13.4959
	(0.36)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)
bs	0.0044	-0.0050	-0.0153	0.0042	-3.3367	-3.3367
	(0.25)	(0.00)	(0.05)	(0.43)	(0.00)	(0.00)
min	0.0033	0.0045	0.0055	0.0033	0.0131	0.0131
	(0.05)	(0.35)	(0.23)	(0.44)	(0.00)	(0.00)
mp	0.0076	0.0020	0.0035	-0.0515	0.0051	0.0051
	(0.17)	(0.07)	(0.19)	(0.00)	(0.06)	(0.06)
mv-c	0.0039	0.0023	0.0032	0.0030	0.0089	0.0089
	(0.29)	(0.09)	(0.29)	(0.41)	(0.06)	(0.06)
bs-c	0.0054	0.0021	0.0031	0.0034	0.0084	0.0084
	(0.37)	(0.04)	(0.21)	(0.46)	(0.13)	(0.13)
min-c	0.0027	0.0047	0.0054	0.0033	0.0086	0.0086
	(0.01)	(0.37)	(0.24)	(0.44)	(0.12)	(0.12)
g-min-c	0.0045	0.0048	0.0051	0.0033	0.0079	0.0079
	(0.03)	(0.39)	(0.28)	(0.44)	(0.23)	(0.23)
mv-min	0.0036	0.0054	-0.2764	0.0034	-0.2258	-0.2258
	(0.13)	(0.47)	(0.00)	(0.49)	(0.00)	(0.00)
ew-min	0.0044	0.0047	0.0052	0.0033	0.0116	0.0116
	(0.06)	(0.38)	(0.23)	(0.36)	(0.00)	(0.00)

Table 23: Turnover

RO_M120_gamma1_sigAlphaNaN_hp1_NonInvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 10$	Industry Portf. $N = 10$	Inter'l Portf. $N = 8$	Mkt/ SMB/HML $N = 2$	FF 1-factor $N = 20$	FF 4-factor $N = 20$
$1/N$	0.0325	0.0233	0.0316	0.0177	0.0162	0.0162
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	25.07	5452.88	7490.20	50.77	23675.74	23675.74
bs	14.48	76.53	164.32	21.26	8952.79	8952.79
min	4.36	7.52	2.77	1.11	46.93	46.93
mp	1.10	10.54	5.90	607.98	1.74	1.74
mv-c	4.26	6.68	6.72	2.18	18.15	18.15
bs-c	3.34	6.83	5.97	2.88	18.03	18.03
min-c	2.18	2.30	1.91	1.11	4.40	4.40
g-min-c	1.24	1.43	1.36	1.11	2.72	2.72
mv-min	13.47	155.31	3887.74	22.32	2494.88	2494.88
ew-min	3.27	5.64	1.97	1.07	31.82	31.82
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0114	0.0560	4.1365	0.0158	159.2914	159.2914
bs	0.0066	0.0214	0.0637	0.0072	37.5261	37.5261
min	0.0037	0.0008	-0.0008	0.0001	-0.0031	-0.0031
mp	0.0000	0.0045	0.0020	0.1003	0.0026	0.0026
mv-c	0.0087	0.0049	0.0033	0.0020	-0.0002	-0.0002
bs-c	0.0060	0.0046	0.0028	0.0004	0.0001	0.0001
min-c	0.0040	-0.0000	-0.0008	0.0001	-0.0017	-0.0017
g-min-c	0.0020	-0.0002	-0.0006	0.0001	-0.0008	-0.0008
mv-min	0.0062	0.0254	1.6998	0.0081	1.3764	1.3764
ew-min	0.0023	0.0003	-0.0005	-0.0000	-0.0029	-0.0029

Table 24: Ranking

RO_M120_gamma1_sigAlphaNaN_hp1_NonInvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 10$	Industry Portf. $N = 10$	Inter'l Portf. $N = 8$	Mkt/ SMB/HML $N = 2$	FF 1-factor $N = 20$	FF 4-factor $N = 20$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	5	6	3	8	8	32	6
mv (in sample)	1	1	1	1	1	1	6	1
mv	10	12	10	11	11	11	65	12
bs	7	11	11	9	10	10	58	10
min	8	6	2	5	2	2	25	3
mp	3	9	7	12	9	9	49	9
mv-c	12	8	9	8	5	5	47	8
bs-c	6	10	8	7	6	6	43	7
min-c	11	4	3	6	4	4	32	5
g-min-c	4	2	4	4	7	7	28	4
mv-min	9	7	12	10	12	12	62	11
ew-min	5	3	5	2	3	3	21	2
Panel B: Rank based on CEQ								
$1/N$	3	3	6	6	8	8	34	4
mv (in sample)	1	1	1	2	1	1	7	1
mv	5	12	11	11	12	12	63	12
bs	7	11	10	1	11	11	51	11
min	11	7	2	7	2	2	31	3
mp	2	10	7	12	9	9	49	10
mv-c	9	8	8	10	4	4	43	8
bs-c	4	9	9	4	6	6	38	6
min-c	12	6	3	9	5	5	40	7
g-min-c	6	4	5	8	7	7	37	5
mv-min	10	2	12	3	10	10	47	9
ew-min	8	5	4	5	3	3	28	2
Panel C: Rank based on Turnover								
$1/N$	1	1	1	1	1	1	6	1
mv	11	11	11	10	11	11	65	11
bs	10	9	9	8	10	10	56	10
min	8	7	5	3	8	8	39	8
mp	2	8	6	11	2	2	31	5
mv-c	7	5	8	6	6	6	38	7
bs-c	6	6	7	7	5	5	36	6
min-c	4	3	3	5	4	4	23	3
g-min-c	3	2	2	4	3	3	17	2
mv-min	9	10	10	9	9	9	56	9
ew-min	5	4	4	2	7	7	29	4

C.6 Tables for benchmark is $1/N$-buy-and-hold, not $1/N$-with-rebalancing

Table 25: Sharpe Ratios

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewBuyHold

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1725	0.1289	0.1129	0.2271	0.1825	0.1934
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.13)	(0.20)	(0.04)	(0.42)	(0.01)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.10)	(0.21)	(0.04)	(0.21)	(0.01)	(0.42)
dm ($\sigma_\alpha = 1.0\%$)	0.1410	0.0581	0.0707	0.0016	0.0004	0.2355
	(0.12)	(0.16)	(0.14)	(0.00)	(0.00)	(0.25)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.10)	(0.24)	(0.10)	(0.25)	(0.02)	(0.00)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.15)	(0.04)	(0.30)	(0.00)	(0.00)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.29)	(0.06)	(0.31)	(0.00)	(0.02)	(0.00)
mv-c	0.0892	0.0678	0.0848	0.1084	0.1977	0.2024
	(0.05)	(0.03)	(0.25)	(0.01)	(0.18)	(0.42)
bs-c	0.1075	0.0819	0.0848	0.1514	0.1955	0.2062
	(0.10)	(0.07)	(0.22)	(0.04)	(0.21)	(0.39)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.07)	(0.33)	(0.07)	(0.25)	(0.07)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.24)	(0.22)	(0.08)	(0.27)	(0.03)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.06)	(0.23)	(0.02)	(0.18)	(0.00)	(0.41)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.17)	(0.14)	(0.05)	(0.20)	(0.01)	(0.00)

Table 26: CEQ Returns

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewBuyHold

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0068	0.0047	0.0040	0.0038	0.0082	0.0080
mv (in sample)	0.0478	0.0106	0.0096	0.0047	0.0300	0.0304
mv	0.0031	-0.7816	-0.1365	0.0045	-2.7142	-0.0829
	(0.27)	(0.00)	(0.00)	(0.21)	(0.00)	(0.01)
bs	0.0030	-0.3157	-0.0312	0.0043	-0.6504	-0.0362
	(0.15)	(0.00)	(0.01)	(0.19)	(0.00)	(0.05)
dm ($\sigma_\alpha = 1.0\%$)	0.0052	-0.0319	0.0021	-0.0084	-0.0296	0.0110
	(0.08)	(0.01)	(0.14)	(0.04)	(0.00)	(0.16)
min	0.0024	0.0052	0.0054	0.0039	0.0100	-0.0002
	(0.06)	(0.37)	(0.12)	(0.46)	(0.21)	(0.00)
vw	0.0053	0.0042	0.0044	0.0042	0.0042	0.0042
	(0.11)	(0.15)	(0.35)	(0.42)	(0.00)	(0.00)
mp	0.0073	0.0014	0.0034	-0.0026	0.0054	0.0053
	(0.31)	(0.07)	(0.32)	(0.04)	(0.03)	(0.03)
mv-c	0.0040	0.0023	0.0032	0.0030	0.0090	0.0075
	(0.26)	(0.12)	(0.37)	(0.29)	(0.16)	(0.41)
bs-c	0.0052	0.0031	0.0031	0.0038	0.0088	0.0074
	(0.33)	(0.19)	(0.31)	(0.50)	(0.23)	(0.39)
min-c	0.0024	0.0047	0.0054	0.0039	0.0060	0.0051
	(0.04)	(0.50)	(0.11)	(0.46)	(0.01)	(0.08)
g-min-c	0.0044	0.0048	0.0051	0.0038	0.0067	0.0070
	(0.14)	(0.44)	(0.13)	(0.49)	(0.00)	(0.25)
mv-min	0.0021	-0.2337	-0.0066	0.0044	-0.0875	-0.0318
	(0.06)	(0.00)	(0.02)	(0.14)	(0.00)	(0.07)
ew-min	0.0037	0.0052	0.0050	0.0039	0.0093	-0.0002
	(0.09)	(0.32)	(0.08)	(0.46)	(0.25)	(0.00)

Table 27: Turnover

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewBuyHold

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	Inf	Inf	Inf	Inf	Inf	Inf
bs	Inf	Inf	Inf	Inf	Inf	Inf
dm ($\sigma_\alpha = 1.0\%$)	Inf	Inf	Inf	Inf	Inf	Inf
min	Inf	Inf	Inf	Inf	Inf	Inf
vw	NaN	NaN	NaN	NaN	NaN	NaN
mp	Inf	Inf	Inf	Inf	Inf	Inf
mv-c	Inf	Inf	Inf	Inf	Inf	Inf
bs-c	Inf	Inf	Inf	Inf	Inf	Inf
min-c	Inf	Inf	Inf	Inf	Inf	Inf
g-min-c	Inf	Inf	Inf	Inf	Inf	Inf
mv-min	Inf	Inf	Inf	Inf	Inf	Inf
ew-min	Inf	Inf	Inf	Inf	Inf	Inf
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0136	227.1006	1.1168	0.0005	8.3424	1.6773
bs	0.0085	9.2955	0.3669	-0.0002	2.3492	1.2626
dm ($\sigma_\alpha = 1.0\%$)	0.0016	8.8252	0.0123	0.0407	0.1405	0.0003
min	0.0043	0.0014	-0.0005	-0.0002	0.0001	0.0026
vw	-0.0006	0.0035	0.0006	0.0164	0.0033	0.0039
mp	-0.0005	0.0049	0.0016	0.0234	0.0035	0.0041
mv-c	0.0075	0.0046	0.0027	0.0044	0.0006	0.0010
bs-c	0.0053	0.0035	0.0024	0.0025	0.0007	0.0008
min-c	0.0037	-0.0002	-0.0012	-0.0002	0.0016	-0.0022
g-min-c	0.0015	-0.0004	-0.0010	-0.0002	0.0012	-0.0025
mv-min	0.0080	6.6926	0.1649	-0.0002	1.0128	2.0347
ew-min	0.0026	0.0006	-0.0006	-0.0002	-0.0002	0.0026

Table 28: Ranking

RO_M120_gamma1_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewBuyHold

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	3	6	7	8	6	7	37	5
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	11	13	9	12	8	66	14
bs	12	10	12	3	11	9	57	10
dm ($\sigma_\alpha = 1.0\%$)	5	13	11	13	13	4	59	12
min	11	3	3	5	2	14	38	6
vw	4	7	6	11	10	12	50	8
mp	2	14	8	14	9	11	58	11
mv-c	9	12	9	12	4	6	52	9
bs-c	8	8	10	10	5	5	46	7
min-c	10	5	2	6	8	2	33	3
g-min-c	6	4	4	7	7	3	31	2
mv-min	14	9	14	2	14	10	63	13
ew-min	7	2	5	4	3	13	34	4
Panel B: Rank based on CEQ								
$1/N$	3	5	7	9	6	3	33	2
mv (in sample)	1	1	1	1	1	1	6	1
mv	10	14	14	2	14	14	68	14
bs	11	13	13	4	13	13	67	13
dm ($\sigma_\alpha = 0.01$)	5	11	11	14	11	2	54	11
min	13	3	2	7	2	11	38	4
vw	4	7	6	5	10	9	41	6
mp	2	10	8	13	9	7	49	10
mv-c	8	9	9	12	4	4	46	9
bs-c	6	8	10	10	5	5	44	8
min-c	12	6	3	6	8	8	43	7
g-min-c	7	4	4	11	7	6	39	5
mv-min	14	12	12	3	12	12	65	12
ew-min	9	2	5	8	3	10	37	3
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	9	12	12	72	13
bs	12	11	12	7	13	11	66	12
dm ($\sigma_\alpha = 1.0\%$)	5	12	10	13	10	10	60	10
min	10	9	9	5	9	7	49	9
vw	1	1	1	1	1	1	6	1
mp	3	7	7	12	4	5	38	5
mv-c	8	5	8	11	7	9	48	8
bs-c	7	6	6	10	6	8	43	7
min-c	6	4	4	4	5	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	8	11	13	64	11
ew-min	9	8	5	6	8	6	42	6

C.7 Tables for different levels of risk aversion

C.7.1 Tables for $\gamma = 2$

Table 29: Sharpe Ratios

RO_M120_gamma2_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 1.0\%$)	0.1410	0.0581	0.0707	0.0016	0.0004	0.2355
	(0.08)	(0.14)	(0.08)	(0.00)	(0.01)	(0.17)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.1167	0.0793	0.0962	0.1242	0.1970	0.2190
	(0.16)	(0.05)	(0.22)	(0.03)	(0.02)	(0.17)
bs-c	0.1304	0.0869	0.1139	0.1736	0.2008	0.2337
	(0.17)	(0.05)	(0.34)	(0.16)	(0.01)	(0.11)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 30: CEQ Returns

RO_M120_gamma2_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0061	0.0040	0.0037	0.0038	0.0058	0.0060
mv (in sample)	0.0357	0.0089	0.0083	0.0045	0.0280	0.0286
mv	-0.0002	-1.6529	-0.2567	0.0042	-5.4583	-0.2819
	(0.16)	(0.00)	(0.00)	(0.33)	(0.00)	(0.00)
bs	0.0014	-0.6940	-0.0558	0.0041	-1.3167	-0.1625
	(0.12)	(0.00)	(0.00)	(0.31)	(0.00)	(0.00)
dm ($\sigma_\alpha = 1.0\%$)	0.0042	-0.0823	0.0012	-0.0171	-0.0592	0.0096
	(0.10)	(0.00)	(0.08)	(0.00)	(0.00)	(0.13)
min	0.0017	0.0045	0.0045	0.0037	0.0092	-0.0002
	(0.04)	(0.39)	(0.22)	(0.48)	(0.07)	(0.01)
vw	0.0044	0.0031	0.0035	0.0031	0.0031	0.0031
	(0.11)	(0.02)	(0.41)	(0.36)	(0.01)	(0.00)
mp	0.0063	0.0003	0.0024	-0.0052	0.0038	0.0038
	(0.28)	(0.04)	(0.16)	(0.01)	(0.08)	(0.06)
mv-c	0.0033	0.0012	0.0023	0.0028	0.0075	0.0068
	(0.27)	(0.07)	(0.26)	(0.26)	(0.03)	(0.34)
bs-c	0.0041	0.0018	0.0032	0.0037	0.0077	0.0068
	(0.27)	(0.07)	(0.38)	(0.47)	(0.02)	(0.35)
min-c	0.0017	0.0039	0.0045	0.0037	0.0050	0.0049
	(0.01)	(0.48)	(0.19)	(0.48)	(0.21)	(0.31)
g-min-c	0.0037	0.0041	0.0042	0.0037	0.0055	0.0067
	(0.05)	(0.47)	(0.24)	(0.43)	(0.30)	(0.33)
mv-min	0.0010	-0.5266	-0.0102	0.0042	-0.1717	-0.1484
	(0.06)	(0.00)	(0.00)	(0.27)	(0.00)	(0.00)
ew-min	0.0031	0.0045	0.0042	0.0037	0.0086	-0.0002
	(0.05)	(0.34)	(0.21)	(0.47)	(0.06)	(0.01)

Table 31: Turnover

RO_M120_gamma2_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 1.0\%$)	1.72	21744.35	60.97	76.30	918.40	32.46
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	3.43	7.21	6.37	3.86	16.66	11.98
bs-c	3.93	8.10	5.01	2.88	15.75	10.50
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	-0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 1.0\%$)	0.0021	8.9987	0.0130	0.0393	0.1302	-0.0007
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	-0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0052	0.0039	0.0025	0.0033	-0.0005	-0.0005
bs-c	0.0036	0.0033	0.0012	0.0014	-0.0008	-0.0010
min-c	0.0042	-0.0001	-0.0007	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0003	0.0001	-0.0029
mv-min	0.0085	6.8115	0.1706	-0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 32: Ranking

RO_M120_gamma2_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	8	6	10	38	6
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	12	13	9	12	7	66	14
bs	12	11	12	3	11	8	57	10
dm ($\sigma_\alpha = 1.0\%$)	5	13	11	13	13	4	59	11
min	11	3	3	5	2	14	38	5
vw	4	7	7	12	10	12	52	9
mp	3	14	9	14	9	11	60	12
mv-c	9	9	10	11	5	6	50	8
bs-c	7	8	8	10	4	5	42	7
min-c	10	5	2	6	8	2	33	3
g-min-c	6	4	4	7	7	3	31	2
mv-min	14	10	14	2	14	9	63	13
ew-min	8	2	5	4	3	13	35	4
Panel B: Rank based on CEQ								
$1/N$	3	5	6	5	6	6	31	2
mv (in sample)	1	1	1	1	1	1	6	1
mv	14	14	14	2	14	14	72	14
bs	12	13	13	4	13	13	68	13
dm ($\sigma_\alpha = 0.01$)	5	11	11	14	11	2	54	11
min	11	3	2	7	2	11	36	3
vw	4	7	7	11	10	9	48	9
mp	2	10	9	13	9	8	51	10
mv-c	8	9	10	12	5	3	47	8
bs-c	6	8	8	9	4	4	39	6
min-c	10	6	3	6	8	7	40	7
g-min-c	7	4	4	10	7	5	37	5
mv-min	13	12	12	3	12	12	64	12
ew-min	9	2	5	8	3	10	37	4
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	9	12	12	72	13
bs	12	11	12	7	13	11	66	12
dm ($\sigma_\alpha = 1.0\%$)	5	12	10	13	10	10	60	10
min	10	9	9	5	9	7	49	9
vw	1	1	1	1	1	1	6	1
mp	3	7	7	12	4	5	38	5
mv-c	7	5	8	11	7	9	47	8
bs-c	8	6	6	10	6	8	44	7
min-c	6	4	4	4	5	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	8	11	13	64	11
ew-min	9	8	5	6	8	6	42	6

C.7.2 Tables for $\gamma = 3$

Table 33: Sharpe Ratios

RO_M120_gamma3_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 1.0\%$)	0.1410	0.0581	0.0707	0.0016	0.0004	0.2355
	(0.08)	(0.14)	(0.08)	(0.00)	(0.01)	(0.17)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.1315	0.0835	0.1111	0.1405	0.2000	0.2359
	(0.19)	(0.05)	(0.33)	(0.06)	(0.01)	(0.10)
bs-c	0.1430	0.0901	0.1224	0.1838	0.2063	0.2596
	(0.19)	(0.06)	(0.43)	(0.20)	(0.00)	(0.04)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 34: CEQ Returns

RO_M120_gamma3_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0052	0.0030	0.0027	0.0036	0.0044	0.0049
mv (in sample)	0.0235	0.0073	0.0069	0.0044	0.0261	0.0268
mv	-0.0036	-2.5241	-0.3770	0.0040	-8.2025	-0.4810
	(0.08)	(0.00)	(0.00)	(0.35)	(0.00)	(0.00)
bs	-0.0002	-1.0723	-0.0803	0.0040	-1.9830	-0.2887
	(0.09)	(0.00)	(0.00)	(0.31)	(0.00)	(0.00)
dm ($\sigma_\alpha = 1.0\%$)	0.0033	-0.1327	0.0002	-0.0257	-0.0889	0.0082
	(0.09)	(0.00)	(0.08)	(0.00)	(0.00)	(0.15)
min	0.0010	0.0037	0.0036	0.0036	0.0085	-0.0003
	(0.04)	(0.33)	(0.21)	(0.50)	(0.04)	(0.02)
vw	0.0034	0.0020	0.0026	0.0020	0.0020	0.0020
	(0.10)	(0.01)	(0.43)	(0.20)	(0.02)	(0.00)
mp	0.0053	-0.0008	0.0014	-0.0078	0.0022	0.0022
	(0.39)	(0.04)	(0.15)	(0.00)	(0.07)	(0.03)
mv-c	0.0026	0.0000	0.0017	0.0027	0.0063	0.0063
	(0.22)	(0.04)	(0.30)	(0.25)	(0.02)	(0.24)
bs-c	0.0034	0.0008	0.0025	0.0034	0.0066	0.0066
	(0.22)	(0.05)	(0.43)	(0.43)	(0.01)	(0.21)
min-c	0.0010	0.0032	0.0036	0.0036	0.0039	0.0048
	(0.01)	(0.44)	(0.17)	(0.50)	(0.33)	(0.48)
g-min-c	0.0030	0.0033	0.0033	0.0035	0.0043	0.0064
	(0.06)	(0.37)	(0.20)	(0.46)	(0.45)	(0.17)
mv-min	-0.0002	-0.8194	-0.0138	0.0041	-0.2560	-0.2651
	(0.05)	(0.00)	(0.00)	(0.27)	(0.00)	(0.00)
ew-min	0.0024	0.0038	0.0033	0.0036	0.0078	-0.0003
	(0.06)	(0.26)	(0.18)	(0.50)	(0.02)	(0.02)

Table 35: Turnover

RO_M120_gamma3_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 1.0\%$)	1.72	21744.35	60.97	76.30	918.40	32.46
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	3.42	7.81	5.98	3.70	15.43	10.34
bs-c	4.11	8.17	4.27	2.67	14.24	8.60
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	-0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 1.0\%$)	0.0021	8.9987	0.0130	0.0393	0.1302	-0.0007
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	-0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0036	0.0036	0.0016	0.0026	-0.0007	-0.0011
bs-c	0.0026	0.0030	0.0007	0.0011	-0.0012	-0.0018
min-c	0.0042	-0.0001	-0.0007	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0003	0.0001	-0.0029
mv-min	0.0085	6.8115	0.1706	-0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 36: Ranking

RO_M120_gamma3_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	8	6	10	38	6
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	12	13	9	12	7	66	14
bs	12	11	12	3	11	8	57	10
dm ($\sigma_\alpha = 1.0\%$)	6	13	11	13	13	6	62	12
min	11	3	3	5	2	14	38	5
vw	4	7	7	12	10	12	52	9
mp	3	14	10	14	9	11	61	11
mv-c	8	9	9	11	5	5	47	8
bs-c	5	8	8	10	4	4	39	7
min-c	10	5	2	6	8	2	33	3
g-min-c	7	4	4	7	7	3	32	2
mv-min	14	10	14	2	14	9	63	13
ew-min	9	2	5	4	3	13	36	4
Panel B: Rank based on CEQ								
$1/N$	3	6	6	8	6	6	35	3
mv (in sample)	1	1	1	1	1	1	6	1
mv	14	14	14	3	14	14	73	14
bs	12	13	13	4	13	13	68	13
dm ($\sigma_\alpha = 0.01$)	6	11	11	14	11	2	55	11
min	11	3	3	6	2	11	36	5
vw	4	7	7	12	10	9	49	9
mp	2	10	10	13	9	8	52	10
mv-c	8	9	9	11	5	5	47	8
bs-c	5	8	8	10	4	3	38	7
min-c	10	5	2	5	8	7	37	6
g-min-c	7	4	4	9	7	4	35	2
mv-min	13	12	12	2	12	12	63	12
ew-min	9	2	5	7	3	10	36	4
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	10	12	12	73	13
bs	12	11	12	7	13	11	66	12
dm ($\sigma_\alpha = 1.0\%$)	5	12	10	13	10	10	60	10
min	10	9	9	5	9	7	49	9
vw	1	1	1	1	1	1	6	1
mp	3	7	8	12	4	5	39	5
mv-c	7	5	7	11	7	9	46	8
bs-c	8	6	6	9	6	8	43	7
min-c	6	4	4	4	5	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	8	11	13	64	11
ew-min	9	8	5	6	8	6	42	6

C.7.3 Tables for $\gamma = 4$

Table 37: Sharpe Ratios

RO_M120_gamma4_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 1.0\%$)	0.1410	0.0581	0.0707	0.0016	0.0004	0.2355
	(0.08)	(0.14)	(0.08)	(0.00)	(0.01)	(0.17)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.1464	0.0862	0.1235	0.1511	0.2056	0.2490
	(0.24)	(0.06)	(0.45)	(0.09)	(0.00)	(0.06)
bs-c	0.1452	0.0881	0.1246	0.2053	0.2077	0.2829
	(0.18)	(0.05)	(0.46)	(0.34)	(0.00)	(0.02)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 38: CEQ Returns

RO_M120_gamma4_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0043	0.0021	0.0018	0.0034	0.0029	0.0038
mv (in sample)	0.0114	0.0056	0.0055	0.0042	0.0241	0.0250
mv	-0.0070	-3.3954	-0.4972	0.0038	-10.9466	-0.6800
	(0.04)	(0.00)	(0.00)	(0.37)	(0.00)	(0.00)
bs	-0.0017	-1.4505	-0.1049	0.0038	-2.6493	-0.4150
	(0.07)	(0.00)	(0.00)	(0.30)	(0.00)	(0.00)
dm ($\sigma_\alpha = 1.0\%$)	0.0023	-0.1830	-0.0007	-0.0343	-0.1185	0.0069
	(0.08)	(0.00)	(0.08)	(0.00)	(0.00)	(0.17)
min	0.0003	0.0030	0.0027	0.0035	0.0077	-0.0003
	(0.05)	(0.28)	(0.20)	(0.47)	(0.02)	(0.05)
vw	0.0025	0.0009	0.0017	0.0009	0.0009	0.0009
	(0.09)	(0.01)	(0.45)	(0.09)	(0.04)	(0.00)
mp	0.0043	-0.0019	0.0004	-0.0104	0.0007	0.0006
	(0.49)	(0.04)	(0.14)	(0.00)	(0.06)	(0.02)
mv-c	0.0022	-0.0012	0.0011	0.0026	0.0053	0.0059
	(0.22)	(0.02)	(0.35)	(0.24)	(0.00)	(0.15)
bs-c	0.0025	-0.0004	0.0016	0.0034	0.0054	0.0064
	(0.18)	(0.03)	(0.44)	(0.48)	(0.00)	(0.11)
min-c	0.0003	0.0025	0.0028	0.0035	0.0029	0.0047
	(0.02)	(0.36)	(0.15)	(0.47)	(0.48)	(0.34)
g-min-c	0.0023	0.0026	0.0025	0.0034	0.0031	0.0061
	(0.08)	(0.27)	(0.17)	(0.49)	(0.39)	(0.07)
mv-min	-0.0013	-1.1123	-0.0175	0.0039	-0.3402	-0.3817
	(0.04)	(0.00)	(0.00)	(0.26)	(0.00)	(0.00)
ew-min	0.0017	0.0031	0.0024	0.0035	0.0071	-0.0003
	(0.07)	(0.19)	(0.16)	(0.47)	(0.01)	(0.05)

Table 39: Turnover

RO_M120_gamma4_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 1.0\%$)	1.72	21744.35	60.97	76.30	918.40	32.46
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	3.83	8.06	5.41	3.38	14.30	9.23
bs-c	4.56	7.71	4.21	2.41	13.42	7.55
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	-0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 1.0\%$)	0.0021	8.9987	0.0130	0.0393	0.1302	-0.0007
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	-0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0025	0.0034	0.0008	0.0021	-0.0011	-0.0015
bs-c	0.0024	0.0030	0.0005	0.0005	-0.0013	-0.0024
min-c	0.0042	-0.0001	-0.0007	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0003	0.0001	-0.0029
mv-min	0.0085	6.8115	0.1706	-0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 40: Ranking

RO_M120_gamma4_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	8	6	10	38	7
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	12	13	9	12	7	66	14
bs	12	11	12	3	11	8	57	10
dm ($\sigma_\alpha = 1.0\%$)	7	13	11	13	13	6	63	13
min	11	3	3	5	2	14	38	6
vw	6	7	8	12	10	12	55	9
mp	3	14	10	14	9	11	61	11
mv-c	4	9	9	11	5	5	43	8
bs-c	5	8	7	10	4	4	38	5
min-c	10	5	2	6	8	2	33	3
g-min-c	8	4	4	7	7	3	33	2
mv-min	14	10	14	2	14	9	63	12
ew-min	9	2	5	4	3	13	36	4
Panel B: Rank based on CEQ								
$1/N$	2	6	6	8	7	7	36	6
mv (in sample)	1	1	1	1	1	1	6	1
mv	14	14	14	4	14	14	74	14
bs	13	13	13	3	13	13	68	13
dm ($\sigma_\alpha = 0.01$)	6	11	11	14	11	2	55	11
min	11	3	3	6	2	11	36	5
vw	4	7	7	12	9	8	47	9
mp	3	10	10	13	10	9	55	10
mv-c	8	9	9	11	5	5	47	8
bs-c	5	8	8	10	4	3	38	7
min-c	10	5	2	5	8	6	36	4
g-min-c	7	4	4	9	6	4	34	2
mv-min	12	12	12	2	12	12	62	12
ew-min	9	2	5	7	3	10	36	3
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	10	12	12	73	13
bs	12	11	12	7	13	11	66	12
dm ($\sigma_\alpha = 1.0\%$)	5	12	10	13	10	10	60	10
min	10	9	9	5	9	7	49	9
vw	1	1	1	1	1	1	6	1
mp	3	7	8	12	4	5	39	5
mv-c	7	6	7	11	7	9	47	8
bs-c	8	5	5	8	6	8	40	6
min-c	6	4	4	4	5	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	9	11	13	65	11
ew-min	9	8	6	6	8	6	43	7

C.7.4 Tables for $\gamma = 5$

Table 41: Sharpe Ratios

RO_M120_gamma5_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 1.0\%$)	0.1410	0.0581	0.0707	0.0016	0.0004	0.2355
	(0.08)	(0.14)	(0.08)	(0.00)	(0.01)	(0.17)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.1500	0.0865	0.1276	0.1614	0.2073	0.2665
	(0.24)	(0.06)	(0.50)	(0.11)	(0.00)	(0.03)
bs-c	0.1486	0.0877	0.1249	0.2222	0.2073	0.2993
	(0.18)	(0.05)	(0.47)	(0.48)	(0.00)	(0.01)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 42: CEQ Returns

RO_M120_gamma5_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0035	0.0011	0.0008	0.0033	0.0015	0.0027
mv (in sample)	-0.0007	0.0039	0.0041	0.0041	0.0221	0.0232
mv	-0.0104	-4.2666	-0.6175	0.0036	-13.6908	-0.8790
	(0.02)	(0.00)	(0.00)	(0.40)	(0.00)	(0.00)
bs	-0.0033	-1.8288	-0.1295	0.0037	-3.3156	-0.5413
	(0.05)	(0.00)	(0.00)	(0.29)	(0.00)	(0.00)
dm ($\sigma_\alpha = 1.0\%$)	0.0014	-0.2334	-0.0017	-0.0430	-0.1482	0.0055
	(0.07)	(0.00)	(0.08)	(0.00)	(0.00)	(0.19)
min	-0.0004	0.0023	0.0018	0.0034	0.0070	-0.0004
	(0.06)	(0.23)	(0.19)	(0.44)	(0.01)	(0.11)
vw	0.0015	-0.0001	0.0008	-0.0001	-0.0001	-0.0001
	(0.08)	(0.00)	(0.48)	(0.03)	(0.08)	(0.00)
mp	0.0033	-0.0030	-0.0006	-0.0130	-0.0009	-0.0009
	(0.38)	(0.03)	(0.13)	(0.00)	(0.06)	(0.01)
mv-c	0.0014	-0.0024	0.0000	0.0024	0.0041	0.0057
	(0.20)	(0.01)	(0.32)	(0.23)	(0.00)	(0.07)
bs-c	0.0018	-0.0014	0.0006	0.0034	0.0041	0.0062
	(0.17)	(0.03)	(0.43)	(0.44)	(0.00)	(0.05)
min-c	-0.0004	0.0018	0.0019	0.0034	0.0018	0.0046
	(0.02)	(0.29)	(0.13)	(0.44)	(0.38)	(0.19)
g-min-c	0.0016	0.0019	0.0016	0.0033	0.0019	0.0058
	(0.10)	(0.19)	(0.15)	(0.48)	(0.25)	(0.02)
mv-min	-0.0025	-1.4051	-0.0211	0.0037	-0.4245	-0.4983
	(0.04)	(0.00)	(0.00)	(0.26)	(0.00)	(0.00)
ew-min	0.0011	0.0024	0.0015	0.0034	0.0063	-0.0003
	(0.09)	(0.14)	(0.14)	(0.43)	(0.00)	(0.11)

Table 43: Turnover

RO_M120_gamma5_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 1.0\%$)	1.72	21744.35	60.97	76.30	918.40	32.46
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	3.96	8.16	5.29	3.15	14.11	8.35
bs-c	4.72	7.43	4.21	2.08	13.13	6.84
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	-0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 1.0\%$)	0.0021	8.9987	0.0130	0.0393	0.1302	-0.0007
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	-0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0022	0.0033	0.0006	0.0017	-0.0012	-0.0020
bs-c	0.0022	0.0029	0.0005	0.0002	-0.0013	-0.0027
min-c	0.0042	-0.0001	-0.0007	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0003	0.0001	-0.0029
mv-min	0.0085	6.8115	0.1706	-0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 44: Ranking

RO_M120_gamma5_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	8	6	10	38	6
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	12	13	10	12	7	67	14
bs	12	11	12	3	11	8	57	10
dm ($\sigma_\alpha = 1.0\%$)	7	13	11	13	13	6	63	13
min	11	3	3	5	2	14	38	5
vw	6	7	9	12	10	12	56	9
mp	3	14	10	14	9	11	61	11
mv-c	4	9	7	11	4	5	40	8
bs-c	5	8	8	9	5	4	39	7
min-c	10	5	2	6	8	2	33	3
g-min-c	8	4	4	7	7	3	33	2
mv-min	14	10	14	2	14	9	63	12
ew-min	9	2	5	4	3	13	36	4
Panel B: Rank based on CEQ								
$1/N$	1	6	6	10	8	7	38	7
mv (in sample)	11	1	1	1	1	1	16	1
mv	14	14	14	4	14	14	74	14
bs	13	13	13	3	13	13	68	13
dm ($\sigma_\alpha = 0.01$)	7	11	11	14	11	5	59	11
min	9	3	3	7	2	10	34	4
vw	5	7	7	12	9	8	48	9
mp	2	10	10	13	10	11	56	10
mv-c	6	9	9	11	5	4	44	8
bs-c	3	8	8	5	4	2	30	3
min-c	10	5	2	6	7	6	36	6
g-min-c	4	4	4	9	6	3	30	2
mv-min	12	12	12	2	12	12	62	12
ew-min	8	2	5	8	3	9	35	5
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	10	12	12	73	13
bs	12	11	12	7	13	11	66	12
dm ($\sigma_\alpha = 1.0\%$)	5	12	10	13	10	10	60	10
min	10	9	9	5	9	7	49	9
vw	1	1	1	1	1	1	6	1
mp	3	7	8	12	4	5	39	5
mv-c	7	6	7	11	7	9	47	8
bs-c	8	5	5	8	6	8	40	6
min-c	6	4	4	4	5	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	9	11	13	65	11
ew-min	9	8	6	6	8	6	43	7

C.7.5 Tables for $\gamma = 10$

Table 45: Sharpe Ratios

RO_M120_gamma10_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 1.0\%$)	0.1410	0.0581	0.0707	0.0016	0.0004	0.2355
	(0.08)	(0.14)	(0.08)	(0.00)	(0.01)	(0.17)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.1647	0.0867	0.1294	0.2096	0.2084	0.3207
	(0.30)	(0.06)	(0.48)	(0.38)	(0.00)	(0.00)
bs-c	0.1515	0.0918	0.1259	0.2480	0.2073	0.3319
	(0.18)	(0.07)	(0.48)	(0.29)	(0.00)	(0.00)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 46: CEQ Returns

RO_M120_gamma10_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	-0.0008	-0.0037	-0.0039	0.0024	-0.0057	-0.0029
mv (in sample)	-0.0614	-0.0044	-0.0029	0.0034	0.0123	0.0142
mv	-0.0273	-8.6228	-1.2187	0.0024	-27.4115	-1.8742
	(0.00)	(0.00)	(0.00)	(0.49)	(0.00)	(0.00)
bs	-0.0111	-3.7201	-0.2524	0.0029	-6.6471	-1.1725
	(0.01)	(0.00)	(0.00)	(0.26)	(0.00)	(0.00)
dm ($\sigma_\alpha = 1.0\%$)	-0.0033	-0.4853	-0.0065	-0.0861	-0.2964	-0.0014
	(0.05)	(0.00)	(0.09)	(0.00)	(0.00)	(0.34)
min	-0.0038	-0.0013	-0.0027	0.0027	0.0033	-0.0006
	(0.12)	(0.07)	(0.16)	(0.31)	(0.00)	(0.19)
vw	-0.0032	-0.0056	-0.0037	-0.0056	-0.0056	-0.0056
	(0.05)	(0.00)	(0.43)	(0.00)	(0.46)	(0.01)
mp	-0.0017	-0.0084	-0.0056	-0.0259	-0.0087	-0.0087
	(0.05)	(0.02)	(0.10)	(0.00)	(0.04)	(0.00)
mv-c	-0.0022	-0.0088	-0.0063	0.0022	-0.0023	0.0049
	(0.24)	(0.00)	(0.10)	(0.40)	(0.00)	(0.00)
bs-c	-0.0020	-0.0066	-0.0044	0.0028	-0.0024	0.0050
	(0.25)	(0.02)	(0.36)	(0.30)	(0.00)	(0.00)
min-c	-0.0040	-0.0017	-0.0024	0.0027	-0.0034	0.0041
	(0.06)	(0.07)	(0.07)	(0.31)	(0.02)	(0.00)
g-min-c	-0.0019	-0.0017	-0.0026	0.0027	-0.0040	0.0044
	(0.25)	(0.02)	(0.06)	(0.34)	(0.01)	(0.00)
mv-min	-0.0082	-2.8694	-0.0392	0.0029	-0.8457	-1.0815
	(0.02)	(0.00)	(0.00)	(0.24)	(0.00)	(0.00)
ew-min	-0.0022	-0.0011	-0.0029	0.0027	0.0026	-0.0005
	(0.23)	(0.02)	(0.07)	(0.28)	(0.00)	(0.19)

Table 47: Turnover

RO_M120_gamma10_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 1.0\%$)	1.72	21744.35	60.97	76.30	918.40	32.46
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	4.14	8.10	5.23	2.24	13.86	5.71
bs-c	4.74	7.14	4.23	1.65	12.38	5.63
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	-0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 1.0\%$)	0.0021	8.9987	0.0130	0.0393	0.1302	-0.0007
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	-0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0015	0.0032	0.0005	0.0004	-0.0013	-0.0031
bs-c	0.0020	0.0027	0.0005	-0.0004	-0.0013	-0.0032
min-c	0.0042	-0.0001	-0.0007	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0003	0.0001	-0.0029
mv-min	0.0085	6.8115	0.1706	-0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 48: Ranking

RO_M120_gamma10_sigAlpha0.010_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	7	9	6	10	40	8
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	12	13	10	12	7	67	14
bs	12	11	12	3	11	8	57	10
dm ($\sigma_\alpha = 1.0\%$)	7	13	11	13	13	6	63	13
min	11	3	3	5	2	14	38	6
vw	6	7	9	12	10	12	56	9
mp	3	14	10	14	9	11	61	11
mv-c	4	9	6	11	4	4	38	7
bs-c	5	8	8	7	5	3	36	5
min-c	10	5	2	6	8	2	33	2
g-min-c	8	4	4	8	7	5	36	4
mv-min	14	10	14	2	14	9	63	12
ew-min	9	2	5	4	3	13	36	3
Panel B: Rank based on CEQ								
$1/N$	1	5	7	9	9	9	40	7
mv (in sample)	14	6	4	1	1	1	27	2
mv	13	14	14	10	14	14	79	14
bs	12	13	13	3	13	13	67	13
dm ($\sigma_\alpha = 0.01$)	8	11	11	14	11	8	63	12
min	9	2	3	6	2	7	29	4
vw	7	7	6	12	8	10	50	9
mp	2	9	9	13	10	11	54	10
mv-c	6	10	10	11	4	3	44	8
bs-c	4	8	8	4	5	2	31	5
min-c	10	3	1	7	6	5	32	6
g-min-c	3	4	2	8	7	4	28	3
mv-min	11	12	12	2	12	12	61	11
ew-min	5	1	5	5	3	6	25	1
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	11	12	12	74	13
bs	12	11	12	8	13	11	67	12
dm ($\sigma_\alpha = 1.0\%$)	5	12	10	13	10	10	60	10
min	10	9	9	5	9	9	51	9
vw	1	1	1	1	1	1	6	1
mp	3	7	8	12	4	5	39	6
mv-c	7	6	7	9	7	7	43	7
bs-c	8	5	5	7	6	6	37	5
min-c	6	4	4	4	5	4	27	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	10	11	13	66	11
ew-min	9	8	6	6	8	8	45	8

C.8 Tables for different levels of confidence in the asset-pricing model

C.8.1 Tables for $\sigma_\alpha = 0.5\%$

Table 49: Sharpe Ratios

RO_M120_gamma1_sigAlpha0.005_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 0.5\%$)	0.1435	-0.0047	0.0754	0.0249	0.0224	0.3469
	(0.09)	(0.01)	(0.10)	(0.00)	(0.01)	(0.00)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.0892	0.0678	0.0848	0.1084	0.1977	0.2024
	(0.09)	(0.03)	(0.17)	(0.02)	(0.02)	(0.27)
bs-c	0.1075	0.0819	0.0848	0.1514	0.1955	0.2062
	(0.14)	(0.06)	(0.15)	(0.09)	(0.03)	(0.25)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 50: CEQ Returns

RO_M120_gamma1_sigAlpha0.005_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0069	0.0050	0.0046	0.0039	0.0073	0.0072
mv (in sample)	0.0478	0.0106	0.0096	0.0047	0.0300	0.0304
mv	0.0031	-0.7816	-0.1365	0.0045	-2.7142	-0.0829
	(0.28)	(0.00)	(0.00)	(0.31)	(0.00)	(0.01)
bs	0.0030	-0.3157	-0.0312	0.0043	-0.6504	-0.0362
	(0.16)	(0.00)	(0.00)	(0.32)	(0.00)	(0.06)
dm ($\sigma_\alpha = 0.5\%$)	0.0053	-0.0037	0.0023	-0.0028	-0.0008	0.0064
	(0.12)	(0.02)	(0.09)	(0.11)	(0.01)	(0.37)
min	0.0024	0.0052	0.0054	0.0039	0.0100	-0.0002
	(0.03)	(0.45)	(0.23)	(0.45)	(0.12)	(0.00)
vw	0.0053	0.0042	0.0044	0.0042	0.0042	0.0042
	(0.12)	(0.04)	(0.39)	(0.44)	(0.00)	(0.00)
mp	0.0073	0.0014	0.0034	-0.0026	0.0054	0.0053
	(0.19)	(0.05)	(0.17)	(0.04)	(0.09)	(0.10)
mv-c	0.0040	0.0023	0.0032	0.0030	0.0090	0.0075
	(0.29)	(0.10)	(0.29)	(0.28)	(0.03)	(0.42)
bs-c	0.0052	0.0031	0.0031	0.0038	0.0088	0.0074
	(0.36)	(0.15)	(0.23)	(0.46)	(0.05)	(0.44)
min-c	0.0024	0.0047	0.0054	0.0039	0.0060	0.0051
	(0.01)	(0.40)	(0.21)	(0.45)	(0.12)	(0.17)
g-min-c	0.0044	0.0048	0.0051	0.0038	0.0067	0.0070
	(0.04)	(0.41)	(0.28)	(0.40)	(0.17)	(0.45)
mv-min	0.0021	-0.2337	-0.0066	0.0044	-0.0875	-0.0318
	(0.07)	(0.00)	(0.01)	(0.28)	(0.00)	(0.07)
ew-min	0.0037	0.0052	0.0050	0.0039	0.0093	-0.0002
	(0.04)	(0.42)	(0.24)	(0.43)	(0.12)	(0.00)

Table 51: Turnover

RO_M120_gamma1_sigAlpha0.005_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 0.5\%$)	0.45	888.94	21.04	113.54	237.36	5.45
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	4.53	7.17	7.23	4.12	17.53	13.82
bs-c	3.64	7.22	6.10	3.65	17.32	13.07
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	-0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 0.5\%$)	0.0018	0.1577	0.0054	0.0417	0.0341	-0.0027
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	-0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0085	0.0048	0.0034	0.0041	-0.0005	0.0002
bs-c	0.0061	0.0038	0.0030	0.0023	-0.0004	-0.0000
min-c	0.0042	-0.0001	-0.0007	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0003	0.0001	-0.0029
mv-min	0.0085	6.8115	0.1706	-0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 52: Ranking

RO_M120_gamma1_sigAlpha0.005_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	8	6	10	38	6
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	11	13	9	13	7	66	14
bs	12	10	12	3	12	8	57	11
dm ($\sigma_\alpha = 0.5\%$)	5	14	11	13	11	3	57	10
min	11	3	3	5	2	14	38	5
vw	4	7	7	11	10	12	51	8
mp	3	13	8	14	9	11	58	12
mv-c	9	12	9	12	4	6	52	9
bs-c	8	8	10	10	5	5	46	7
min-c	10	5	2	6	8	2	33	3
g-min-c	6	4	4	7	7	4	32	2
mv-min	14	9	14	2	14	9	62	13
ew-min	7	2	5	4	3	13	34	4
Panel B: Rank based on CEQ								
$1/N$	3	4	6	6	6	4	29	2
mv (in sample)	1	1	1	1	1	1	6	1
mv	10	14	14	2	14	14	68	14
bs	11	13	13	4	13	13	67	13
dm ($\sigma_\alpha = 0.01$)	5	11	11	14	11	6	58	11
min	13	3	2	8	2	11	39	5
vw	4	7	7	5	10	9	42	7
mp	2	10	8	13	9	7	49	10
mv-c	8	9	9	12	4	2	44	9
bs-c	6	8	10	10	5	3	42	6
min-c	12	6	3	7	8	8	44	8
g-min-c	7	5	4	11	7	5	39	4
mv-min	14	12	12	3	12	12	65	12
ew-min	9	2	5	9	3	10	38	3
Panel C: Rank based on Turnover								
$1/N$	3	2	2	2	2	2	13	2
mv	13	13	13	9	12	12	72	13
bs	12	12	12	7	13	11	67	12
dm ($\sigma_\alpha = 0.5\%$)	2	10	10	13	10	6	51	10
min	10	9	9	5	9	8	50	9
vw	1	1	1	1	1	1	6	1
mp	4	7	7	12	4	5	39	5
mv-c	8	5	8	11	7	10	49	8
bs-c	7	6	6	10	6	9	44	7
min-c	6	4	4	4	5	4	27	4
g-min-c	5	3	3	3	3	3	20	3
mv-min	11	11	11	8	11	13	65	11
ew-min	9	8	5	6	8	7	43	6

C.8.2 Tables for $\sigma_\alpha = 2\%$

Table 53: Sharpe Ratios

RO_M120_gamma1_sigAlpha0.020_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.1876	0.1353	0.1277	0.2240	0.1623	0.1753
mv (in sample)	0.3848	0.2124	0.2090	0.2851	0.5098	0.5364
mv	0.0794	0.0679	-0.0332	0.2186	0.0128	0.1841
	(0.12)	(0.17)	(0.03)	(0.46)	(0.02)	(0.45)
bs	0.0811	0.0719	-0.0297	0.2536	0.0138	0.1791
	(0.09)	(0.19)	(0.03)	(0.25)	(0.02)	(0.48)
dm ($\sigma_\alpha = 2.0\%$)	0.1321	-0.0543	0.0740	0.1264	-0.0674	0.1073
	(0.08)	(0.00)	(0.15)	(0.04)	(0.00)	(0.17)
min	0.0820	0.1554	0.1490	0.2493	0.2778	-0.0183
	(0.05)	(0.30)	(0.21)	(0.23)	(0.01)	(0.01)
vw	0.1444	0.1138	0.1239	0.1138	0.1138	0.1138
	(0.09)	(0.01)	(0.43)	(0.00)	(0.01)	(0.00)
mp	0.1863	0.0533	0.0984	-0.0002	0.1238	0.1230
	(0.44)	(0.04)	(0.15)	(0.00)	(0.08)	(0.03)
mv-c	0.0892	0.0678	0.0848	0.1084	0.1977	0.2024
	(0.09)	(0.03)	(0.17)	(0.02)	(0.02)	(0.27)
bs-c	0.1075	0.0819	0.0848	0.1514	0.1955	0.2062
	(0.14)	(0.06)	(0.15)	(0.09)	(0.03)	(0.25)
min-c	0.0834	0.1425	0.1501	0.2493	0.1546	0.3580
	(0.01)	(0.41)	(0.16)	(0.23)	(0.35)	(0.00)
g-min-c	0.1371	0.1451	0.1429	0.2467	0.1615	0.3028
	(0.08)	(0.31)	(0.19)	(0.25)	(0.47)	(0.00)
mv-min	0.0683	0.0772	-0.0353	0.2546	-0.0079	0.1757
	(0.05)	(0.21)	(0.01)	(0.22)	(0.01)	(0.50)
ew-min	0.1208	0.1576	0.1407	0.2503	0.2608	-0.0161
	(0.07)	(0.21)	(0.18)	(0.17)	(0.00)	(0.01)

Table 54: CEQ Returns

RO_M120_gamma1_sigAlpha0.020_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0069	0.0050	0.0046	0.0039	0.0073	0.0072
mv (in sample)	0.0478	0.0106	0.0096	0.0047	0.0300	0.0304
mv	0.0031	-0.7816	-0.1365	0.0045	-2.7142	-0.0829
	(0.28)	(0.00)	(0.00)	(0.31)	(0.00)	(0.01)
bs	0.0030	-0.3157	-0.0312	0.0043	-0.6504	-0.0362
	(0.16)	(0.00)	(0.00)	(0.32)	(0.00)	(0.06)
dm ($\sigma_\alpha = 2.0\%$)	0.0049	-0.6417	0.0026	0.0034	-4.3140	-0.0040
	(0.11)	(0.00)	(0.23)	(0.35)	(0.00)	(0.20)
min	0.0024	0.0052	0.0054	0.0039	0.0100	-0.0002
	(0.03)	(0.45)	(0.23)	(0.45)	(0.12)	(0.00)
vw	0.0053	0.0042	0.0044	0.0042	0.0042	0.0042
	(0.12)	(0.04)	(0.39)	(0.44)	(0.00)	(0.00)
mp	0.0073	0.0014	0.0034	-0.0026	0.0054	0.0053
	(0.19)	(0.05)	(0.17)	(0.04)	(0.09)	(0.10)
mv-c	0.0040	0.0023	0.0032	0.0030	0.0090	0.0075
	(0.29)	(0.10)	(0.29)	(0.28)	(0.03)	(0.42)
bs-c	0.0052	0.0031	0.0031	0.0038	0.0088	0.0074
	(0.36)	(0.15)	(0.23)	(0.46)	(0.05)	(0.44)
min-c	0.0024	0.0047	0.0054	0.0039	0.0060	0.0051
	(0.01)	(0.40)	(0.21)	(0.45)	(0.12)	(0.17)
g-min-c	0.0044	0.0048	0.0051	0.0038	0.0067	0.0070
	(0.04)	(0.41)	(0.28)	(0.40)	(0.17)	(0.45)
mv-min	0.0021	-0.2337	-0.0066	0.0044	-0.0875	-0.0318
	(0.07)	(0.00)	(0.01)	(0.28)	(0.00)	(0.07)
ew-min	0.0037	0.0052	0.0050	0.0039	0.0093	-0.0002
	(0.04)	(0.42)	(0.24)	(0.43)	(0.12)	(0.00)

Table 55: Turnover

RO_M120_gamma1_sigAlpha0.020_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$
$1/N$	0.0305	0.0216	0.0293	0.0237	0.0162	0.0198
Panel A: Relative turnover of each strategy						
mv (in sample)	–	–	–	–	–	–
mv	38.99	606594.36	4475.81	2.83	10466.10	3553.03
bs	22.41	10621.23	1777.22	1.85	11796.47	3417.81
dm ($\sigma_\alpha = 2.0\%$)	5.69	11716.23	220.23	3.86	12031.14	1440.25
min	6.54	21.65	7.30	1.11	45.47	6.83
vw	0	0	0	0	0	0
mp	1.10	11.98	6.29	59.41	2.39	2.07
mv-c	4.53	7.17	7.23	4.12	17.53	13.82
bs-c	3.64	7.22	6.10	3.65	17.32	13.07
min-c	2.47	2.58	2.27	1.11	3.93	1.76
g-min-c	1.30	1.52	1.47	1.09	1.78	1.70
mv-min	19.82	9927.09	760.57	2.61	4292.16	4857.19
ew-min	4.82	15.66	4.24	1.11	34.10	6.80
Panel B: Return loss relative to $1/N$ (per month)						
mv (in sample)	–	–	–	–	–	–
mv	0.0145	231.8504	1.1689	0.0003	7.4030	1.5740
bs	0.0092	9.4602	0.3798	-0.0004	2.0858	1.1876
dm ($\sigma_\alpha = 2.0\%$)	0.0032	5.7064	0.0494	0.0032	21.3420	0.2044
min	0.0048	0.0015	0.0000	-0.0004	-0.0008	0.0024
vw	-0.0001	0.0037	0.0012	0.0157	0.0021	0.0028
mp	0.0001	0.0050	0.0021	0.0227	0.0023	0.0030
mv-c	0.0085	0.0048	0.0034	0.0041	-0.0005	0.0002
bs-c	0.0061	0.0038	0.0030	0.0023	-0.0004	-0.0000
min-c	0.0042	-0.0001	-0.0007	-0.0004	0.0006	-0.0025
g-min-c	0.0019	-0.0003	-0.0006	-0.0003	0.0001	-0.0029
mv-min	0.0085	6.8115	0.1706	-0.0003	0.9306	1.8979
ew-min	0.0030	0.0008	-0.0001	-0.0004	-0.0011	0.0024

Table 56: Ranking

RO_M120_gamma1_sigAlpha0.020_hp1_InvestableFactors_Rolling_ewRebal

Strategy	S&P Sectors $N = 11$	Industry Portf. $N = 11$	Inter'l Portf. $N = 9$	Mkt/ SMB/HML $N = 3$	FF 1-factor $N = 21$	FF 4-factor $N = 24$	Total of ranks	Final Rank
Panel A: Rank based on Sharpe ratio								
$1/N$	2	6	6	8	6	9	37	5
mv (in sample)	1	1	1	1	1	1	6	1
mv	13	11	13	9	12	6	64	13
bs	12	10	12	3	11	7	55	10
dm ($\sigma_\alpha = 2.0\%$)	6	14	11	11	14	12	68	14
min	11	3	3	5	2	14	38	6
vw	4	7	7	12	10	11	51	8
mp	3	13	8	14	9	10	57	11
mv-c	9	12	9	13	4	5	52	9
bs-c	8	8	10	10	5	4	45	7
min-c	10	5	2	6	8	2	33	3
g-min-c	5	4	4	7	7	3	30	2
mv-min	14	9	14	2	13	8	60	12
ew-min	7	2	5	4	3	13	34	4
Panel B: Rank based on CEQ								
$1/N$	3	4	6	6	6	4	29	2
mv (in sample)	1	1	1	1	1	1	6	1
mv	10	14	14	2	13	14	67	14
bs	11	12	13	4	12	13	65	12
dm ($\sigma_\alpha = 0.02$)	6	13	11	12	14	11	67	13
min	13	3	2	8	2	10	38	4
vw	4	7	7	5	10	8	41	7
mp	2	10	8	14	9	6	49	10
mv-c	8	9	9	13	4	2	45	9
bs-c	5	8	10	10	5	3	41	6
min-c	12	6	3	7	8	7	43	8
g-min-c	7	5	4	11	7	5	39	5
mv-min	14	11	12	3	11	12	63	11
ew-min	9	2	5	9	3	9	37	3
Panel C: Rank based on Turnover								
$1/N$	2	2	2	2	2	2	12	2
mv	13	13	13	9	11	12	71	13
bs	12	11	12	7	12	11	65	12
dm ($\sigma_\alpha = 2.0\%$)	9	12	10	11	13	10	65	11
min	10	9	9	5	9	7	49	9
vw	1	1	1	1	1	1	6	1
mp	3	7	7	13	4	5	39	5
mv-c	7	5	8	12	7	9	48	8
bs-c	6	6	6	10	6	8	42	7
min-c	5	4	4	4	5	4	26	4
g-min-c	4	3	3	3	3	3	19	3
mv-min	11	10	11	8	10	13	63	10
ew-min	8	8	5	6	8	6	41	6

References

Agnew, J., P. Balduzzi, and A. Sunden, 2003, "Portfolio Choice and Trading in a Large 401(k) Plan," *American Economic Review*, 93, 193–215.

Carhart, M., 1997, "On the Persistence in Mutual Fund Performance," *Journal of Finance*, 52, 57–82.

Chan, L. K. C., J. Karceski, and J. Lakonishok, 1999, "On Portfolio Optimization: Forecasting Covariances and Choosing the Risk Model," *Review of Financial Studies*, 12, 937–974.

Choi, J. J., D. Laibson, B. C. Madrian, and A. Metrick, 2001, "Defined Contribution Pensions: Plan Rules, Participant Decisions, and the Path of Least Resistance," NBER working paper 8655.

Choi, J. J., D. Laibson, B. C. Madrian, and A. Metrick, 2004, "Employees' Investment Decisions About Company Stock," NBER working paper 10228.

Haff, L., 1979, "An Identity for the Wishart Distribution with Applications," *Journal of Multivariate Analysis*, 9, 531–544.

Jagannathan, R., and T. Ma, 2003, "Risk Reduction in Large Portfolios: Why Imposing the Wrong Constraints Helps," *Journal of Finance*, 58, 1651–1684.

Jorion, P., 1985, "International Portfolio Diversification with Estimation Risk," *Journal of Business*, 58, 259–278.

Jorion, P., 1986, "Bayes-Stein Estimation for Portfolio Analysis," *Journal of Financial and Quantitative Analysis*, 21, 279–292.

Kan, R., and G. Zhou, 2005, "Optimal Portfolio Choice with Parameter Uncertainty," forthcoming in *Journal of Financial and Quantitative Analysis*.

MacKinlay, A. C., and L. Pastor, 2000, "Asset Pricing Models: Implications for Expected Returns and Portfolio Selection," *Review of Financial Studies*, 13, 883–916.

Madrian, B. C., and D. F. Shea, 2000, "The Power of Suggestion: Inertia in 401(K) Participation and Savings Behavior," NBER working paper 7682.

Pástor, Ľ., 2000, "Portfolio Selection and Asset Pricing Models," *Journal of Finance*, 55, 179–223.

Pástor, Ľ., and R. F. Stambaugh, 2000, "Comparing Asset Pricing Models: An Investment Perspective," *Journal of Financial Economics*, 56, 335–381.

Wang, Z., 2005, "A Shrinkage Approach to Model Uncertainty and Asset Allocation," *The Review of Financial Studies*, 18, 673–705.