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RESEARCH INSIGHTS

Far From the Madding Crowd* – Volatility Efficient Indices | April 2008

* *Thomas Gray - Elegy Written in a Country Churchyard:*
'Far from the madding crowd's ignoble strife,
Their sober wishes never learn'd to stray;
Along the cool sequester'd vale of life
They kept the noiseless tenor of their way.'

Frank Nielsen

Raman Aylursubramanian

Abstract

Minimum-variance and managed volatility equity strategies have been around since the early 1990s but have recently gained popularity. Since minimum variance strategies do not require return forecasts, they may be in some cases more efficient than strategies that trade off expected risk and return. Moreover, new pension regulations in the US and abroad have led to increased aversion against asset volatility. We developed a global minimum volatility (MV) index that can serve as a transparent and relevant benchmark for managed volatility equity strategies. Our global MSCI MV Index performance profile is consistent with earlier studies of minimum variance portfolios for US and European markets. The simulated MSCI MV World Index experienced approximately 30% lower volatility than the MSCI World Index over the period June 1995 to December 2007. Its performance, measured by the Sharpe ratio, was 0.67 vs. 0.45 for the MSCI World Index during this period.

Introduction

With the recent increase in equity volatility, combined with legislation and accounting changes that require mark-to-market of asset values at pension plans and insurance companies, a number of 'managed volatility' equity strategies have emerged. These strategies focus on absolute return and volatility instead of active return and tracking error relative to a standard equity benchmark. The so-called 'minimum variance' strategy, which harkens back to the well-known minimum variance portfolio (MV) represents the extreme form of such equity strategies. In fact, the MV portfolio can be viewed as a passive managed volatility strategy. In this paper, we explore the merits of developing a global minimum volatility (MV) index that can function as a benchmark for managed volatility strategies.

In Section 1, we provide a brief overview of the MV portfolio in its theoretical context and review the existing literature dealing with empirical analysis of MV portfolios. A number of studies, most focused on the US and other domestic markets, report realized superior risk adjusted returns for

the MV portfolio over capitalization weighted market indices during different economic cycles. In Section 2, we describe how to construct a MV Index given a number of constraints that aim to make the MV Index a relevant benchmark for managed volatility strategies. Next, we report our results and the characteristics of the global MV Index. We compare this MV Index to the MSCI World Index as well as a long duration fixed income (FI) index, a benchmark for less risky long-term investments and proxy for long duration liabilities. In Section 3, we conclude the paper with a discussion of possible applications of a global MV Index.

I. The Minimum Variance Portfolio

The theoretical minimum variance (MV) portfolio has been widely known since Markowitz's seminal paper in 1952.[1] The MV portfolio is positioned on the very left tip of a mean-variance efficient frontier and describes an equity portfolio with the lowest return-variance for a given covariance matrix of stock returns. While all other portfolios on the efficient frontier minimize risk for a given expected return, the MV portfolio minimizes risk without an expected return input.

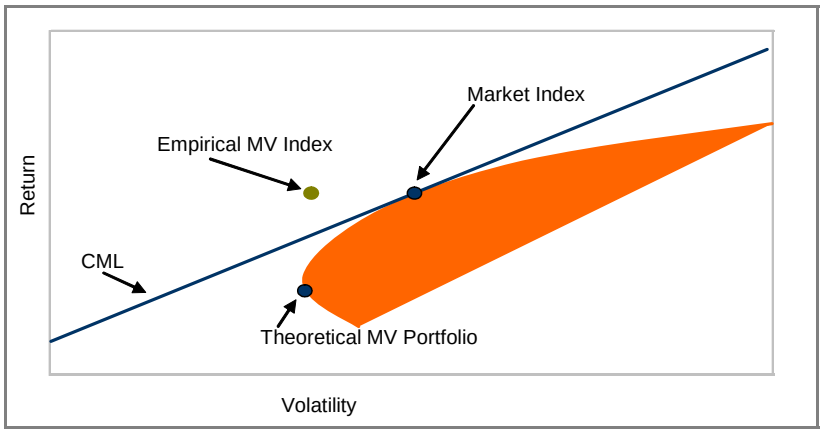
The Capital Asset Pricing Model (CAPM) (see Sharpe, 1964) expanded on the ideas of Markowitz and developed the concept of the mean-variance efficient market portfolio – the only portfolio of risky assets an investor should hold (given a strict set of assumptions).[2] Combining the market portfolio with a risk free asset[3] will then allow the manager to achieve the desired risk level. Capitalization weighted equity indices like the MSCI World Index for global equity investors often function as a proxy for the market portfolio. Thus, if an investor wants to maximize return per unit of risk, the market portfolio or any combination of the market portfolio and cash dominate the MV portfolio according to the CAPM.

Of course, in practice, the CAPM has not always stood up well to empirical evidence. Academics and investment professionals agree that many of the underlying assumptions of the CAPM did not pass the test of empirical studies, and that the proxy for the market portfolio may not be mean-variance efficient itself. Figure 1 illustrates an efficient frontier and the capital market line as a combination of the risk-free asset and the market portfolio, represented by a capitalization weighted, well-diversified index.

[1] See Markowitz, H. (1952), Portfolio Selection, Journal of Finance, 7
[2] Sharpe, William (1964), Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, Journal of Finance, 19
[3] The different combinations of a risk free asset and the market portfolio form the tangent, known as the capital market line (CML).

In Figure 1, we also illustrate an Empirical MV Index, reflecting the observation that the bulk of empirical studies report superior realized risk-adjusted performance for the MV portfolio relative to capitalization weighted market indices.

Figure 1: Efficient Frontier and Empirical MV Index results



The results of these studies suggest that the CAPM does not hold in practice or at least that the capitalization weighted proxy for the market portfolio may not be a truly efficient investment.

What are some of the characteristics of empirical minimum-variance portfolios? Across a number of empirical studies, MV portfolios show a number of common characteristics that may also explain their historically superior risk adjusted returns:[4]

- Low Portfolio Beta, in the order of 0.7, relative to a capitalization weighted market index
- Approximately 30% less portfolio volatility than the capitalization weighted market index
- Bias towards stocks with lower market capitalization than the average company within the capitalization weighted market index
- Bias towards stocks with low total and idiosyncratic risk
- Often a bias towards value oriented companies

Thus, one reason why MV portfolios have historically exhibited strong realized risk adjusted performance may be their lower cap and value biases relative to a capitalization weighted index. A second reason may be their bias towards low idiosyncratic risk. Recent studies report that

[4] The original study was published by Haugen in 1990 for the US. In 1995 Kleeberg showed similar results for international markets. In 2006 Clarke et al, repeated Haugen's tests for longer and more recent periods.

stocks with low idiosyncratic risk outperformed stocks with higher risk over long periods.[5] A third reason may be the lower absolute return volatility of the MV portfolio. Lower volatility combined with comparable average monthly performance leads to higher long-term compounded (geometric) returns relative to a more volatile return series.

Last, but not least, a common explanation for the superior realized risk adjusted performance of the MV portfolio has to do with the practical challenges of constructing efficient portfolios. Past studies suggest that accurately estimating risk may be a more straightforward task than estimating expected returns.[6] Moreover, Chopra and Ziemba (1993) examined the relative impact of estimation errors in means, variances, and covariances. They found that errors in means are more than ten times as important as errors in variances and errors in variances are about twice as important as errors in covariances.[7] As a result, the minimum variance portfolio, which does not rely on expected return forecasts, might be the best way at creating an efficient portfolio and empirical studies point in that direction.[8]

II. The MSCI Minimum Volatility World Index

Construction Methodology

In this section, we describe our methodology for constructing a global minimum-volatility (MV) index based on the MSCI World Index security universe. The critical input in a MV Index is the risk estimate, the covariance matrix of equity returns. While return history can be used to create this sample covariance matrix, a more robust covariance matrix would take into account errors in estimation that arise from using pure historical returns. Hence, we use the global equity covariance matrix from the Barra Global Equity Model (GEM) as our input.[9]

A major consideration for the construction of the MV Index is investability and replicability under realistic assumptions. Consequently, we implement a number of rules to ensure these two objectives and rebalance the MV Index semi-annually with the following constraints:[10]

[5] See Ang et al (2006a), and Ang et al (2006b), For their analysis using U.S. data, the sample period is July 1963 to December 2003. For the international data, the sample period is January 1980 to December 2003. Stocks with recent past high idiosyncratic volatility had low future average returns around the world, on average, across 23 developed markets, the difference between the extreme quintile portfolios sorted on idiosyncratic volatility was 1.31% per month in favor of the low volatility quintile.

[6] Jagannathan and Ma (2003), for example, comment that the estimation error in expected returns is so large that nothing much is lost in ignoring them altogether.

[7] See Chopra, Vijay K. and William T. Ziemba (1993), They point out that errors in expected return forecasts have a 10 times larger impact on portfolio construction than errors in the estimation of the co-variances across assets

[8] See Jorion (1986), Jagannathan and Ma (2003), DeMiguel et al. (2005). All show empirical evidence that the minimum- variance portfolio performed better out-of-sample than any other mean-variance portfolio.

[9] For details on the Global Equity Model please go to www.mscibarra.com/products/models/global.jsp

[10] We also simulated an unconstrained MV index and indices with different constraints and rebalancing frequencies. Results of these simulations are available on request

- The index is un-hedged and constructed from a US dollar perspective[11]
- The maximum weight of an index constituent is constrained to 1.5%.
- The minimum weight of an index constituent is constrained to 0.05%.
- The GICS sector weights of the MV Index are constrained to +/-5% around the GICS sector weights of the MSCI World Index.
- The country weights of the MV Index are constrained to +/-5% around the country weights of the MSCI World Index.
- The Barra risk index exposures of the MV Index are constrained to +/- 0.25 standard deviations around the Barra risk index exposures of the MSCI World Index.[12]
- The one-way index turnover is constrained to a maximum of 10% per semi-annual rebalancing.

Given these constraints, we constructed the MSCI World MV Index from June 1995 to December 2007[13] using the MSCI Barra Aegis optimizer.[14] Next, we present the performance characteristics of this MV Index.

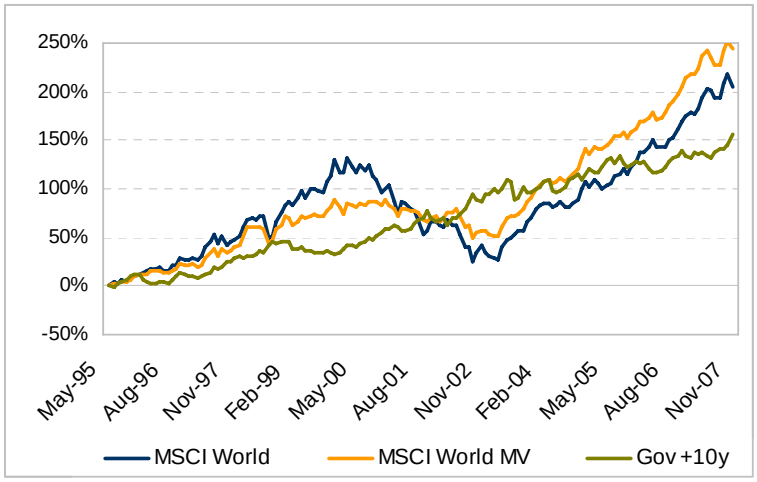
Performance Characteristics of the MSCI Minimum Volatility World Index

Figure 2 shows the cumulative returns over the entire period for the global MV Index against the MSCI World Index and a long duration US Fixed Income Index. The latter is constructed using government bond issues with more than 10 years to maturity. The MSCI MV Index realized somewhat higher returns than the MSCI World Index over the period from June 1995 to December 2007 with nearly 30% lower volatility.

As one might expect, the MSCI World Index delivered superior returns during the tech boom and internet bubble of the late 1990s. However, the MSCI World Index performed much worse than the MV Index when the bubble burst. From the top of the tech boom in March 2000 to the bottom in March 2003, the MSCI World Index lost 45% whereas the MSCI MV Index lost less than 18%.

[11] A different base currency would lead to a different MV index, i.e., the US dollar based MV Index is the minimum volatility index only for US dollar based investors.
[12] The Barra risk indices are SIZE, VALUE, MOMENTUM, and VOLATILITY. Their exposures are Z-scores with a mean of zero and standard deviation of 1.
[13] The official history for the MSCI MV index starts in December 1998. The period from June 1995 to November 1998 is based on the simulated research history of the parent index, which may not always perfectly matched the official MSCI parent index history.
[14] A detailed methodology guide for the construction and maintenance of the MV Index is available on request

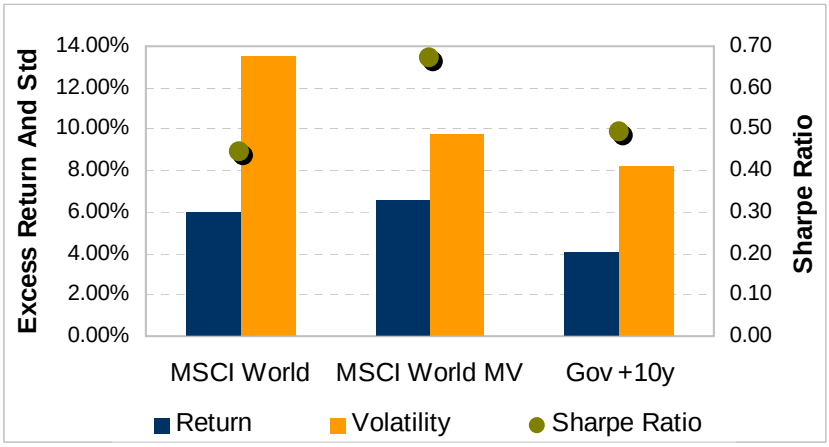
Figure 2: Cumulative Excess Returns from May 1995 to December 2007



The other intriguing result is that the two indices performed very similarly during the periods from June 1995 to November 1998, and from April 2003 to December 2007. In other words, during the period of steep decline the MV Index indeed offered downside protection relative to a capitalization-weighted index but kept up with the capitalization-weighted index during up-markets in the mid 1990s and 2000s.

Figure 3 highlights the superior performance per unit of risk of the MSCI MV World index over this period. The higher Sharpe Ratio of the MV Index, defined as annualized excess return (in excess of 1 month T-Bill) divided by realized annualized volatility, can be explained mostly by the lower volatility relative to the MSCI World Index. The long duration bond index delivered lower returns combined with lower risk, resulting in a Sharpe Ratio comparable to the MSCI World Index.

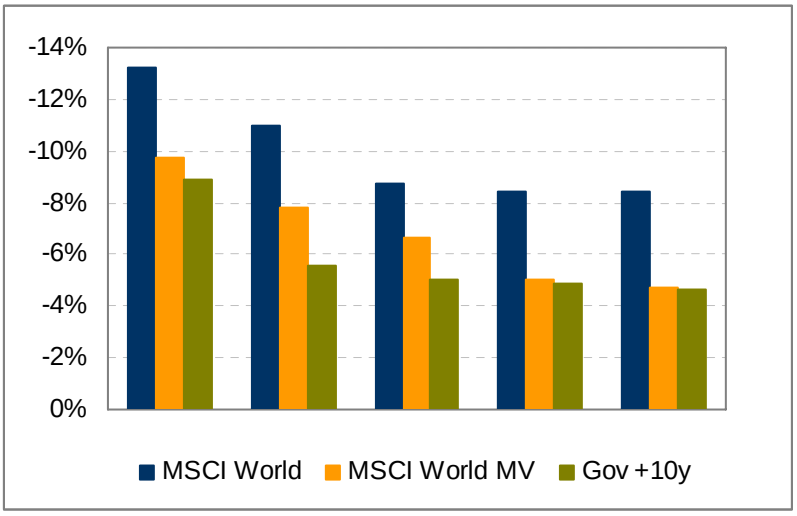
Figure 3: Annualized Risk and Return Comparison



The MV Index realized risk over this period similar to the level of the Fixed Income index, i.e., 9.75% vs. 8.20% p.a., respectively, whereas the MSCI World Index experienced risk of 13.50% annualized. Even though, the MV Index is fully invested in equities its absolute level of volatility was more comparable to long duration fixed income or long liability streams, as approximated by the long duration fixed income index.

Next, an important attraction of managed volatility equity investing is its downside protection relative to a market index. Figure 4 looks at the 5 worst performing months for the three indices over the period from June 1995 to December 2007.

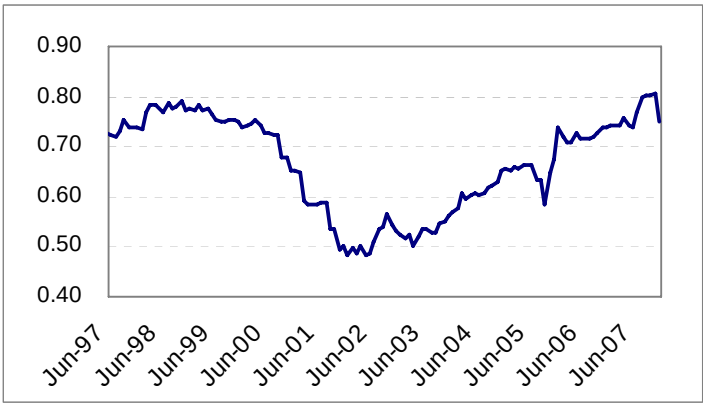
Figure 4: Worst five monthly returns from June 1995 to December 2007



Again, the worst monthly MV Index losses are closer to the biggest fixed income index declines over this period.

Finally, we look at the beta of the MSCI MV Index against the MSCI World Index. As expected, the beta, measured as a rolling 36-month historical beta, is consistently below one and varied between 0.8 and 0.5.

Figure 5: MSCI MV World 36 month rolling Beta vs MSCI World

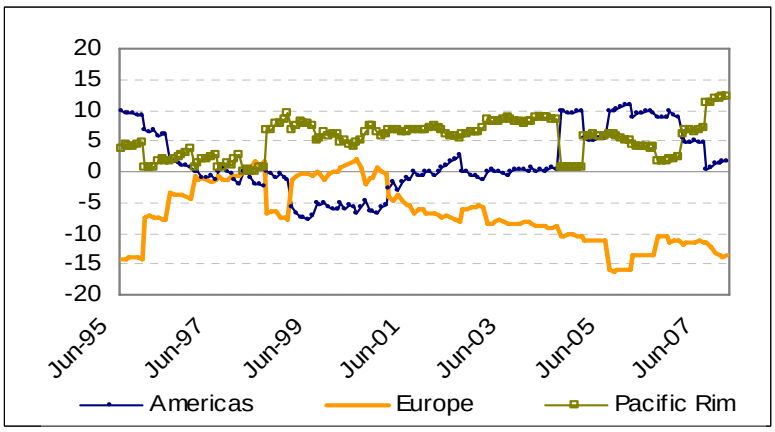


Interestingly, the MV Index seemed to have offered a natural hedge against increasing market volatility. The beta declined rapidly during the late 1990s and early 2000s when market volatility skyrocketed.

Characteristics of the MSCI Minimum Volatility World Index

Next, we investigate the MSCI MV World index characteristics in more detail. Figure 6 shows the exposures to the three regions over time. The MSCI MV World index under-weighed Europe most of the time and over-weighed Asia Pacific. The Americas weight is on average relatively close to the MSCI World Index but varies during this period.

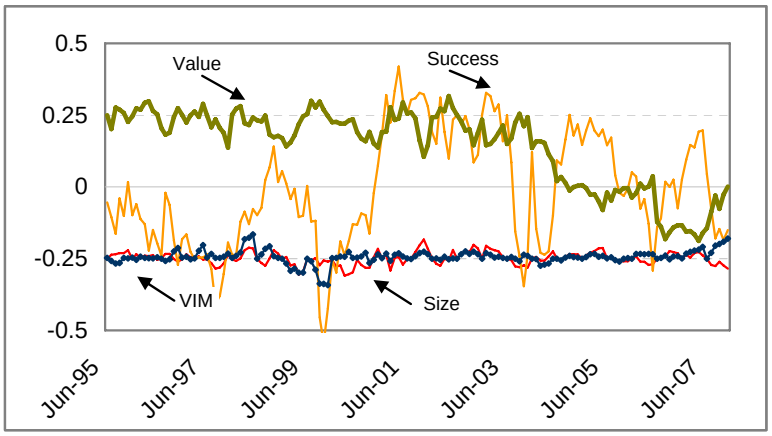
Figure 6: Regional weights relative to the MSCI World Index



The main reason for the lower Europe weights was the exchange rate volatility between the Euro and USD whereas currency risk in Asia had been more muted over most of the last 12 years, making Asia Pacific relatively more attractive for managed volatility equity strategies.[15]

Figure 7 demonstrates the evolution of the style index exposures over time. The constraint of +/- 0.25 standard deviations at each semi-annual rebalancing controlled the index from moving more towards smaller stocks within the MSCI World universe and stocks with lower historical volatility as measured by VIM (Variability in Markets).

Figure 7: MSCI MV World Style exposure over time



This bias towards smaller and less volatile stocks is in line with previous studies. More surprising is the move away from 'Value' during the recent bull market from 2003 to 2007, an indication that value stocks have become more volatile in recent years and therefore lost their appeal for the MV Index.

We conclude that the performance characteristics of the MSCI MV World index are very much in line with previous studies focusing on domestic minimum variance portfolios. In the next section, we discuss potential applications of such an index.

III. Applications

Given the MV Index's risk adjusted performance and less extreme returns, it may be an attractive benchmark for investors with low volatility equity strategies such as corporate pension plans, insurance companies, or others. Some of these investors are increasingly concerned about

[15] If the base currency for the MV index were Euro, the resulting MV index would be different and Asia and the US would likely be underweighted relative to Europe.

balance sheet volatility in light of new regulations, such as FAS 158 and the Pension Protection Act. Both regulatory changes (and similar ones in Europe) have led to an increased focus on asset-liability-management (ALM) and liability driven investing (LDI) in recent years.

To quantify the impact of low volatility investing on the overall level of risk for a typical asset allocation of 60% equity and 40% fixed income, figure 8 illustrates the result for two asset allocations using the MSCI World index and the MSCI MV Index as the respective equity components. For the 'traditional' asset allocation, we use the MSCI World Index as the equity element and the US Fixed Income government index. For the MV asset allocation, we use the MSCI MV Index and the same US Fixed Income Index.

Figure 8: Asset Allocation using the MSCI World and MSCI MV Indices

December-07	Asset Allocation	Traditional Asset Allocation Risk	MV Asset Allocation Risk	Risk Reduction
Equity	60%	12.1%	8.8%	27%
Fixed Income	40%	8.0%	8.0%	0%
Total	**100%**	**7.0%**	**5.8%**	**18%**
April-01	**Asset Allocation**	**Traditional Asset Allocation Risk**	**MV Asset Allocation Risk**	**Risk Reduction**
Equity	60%	14.7%	10.8%	27%
Fixed Income	40%	7.2%	7.2%	0%
Total	**100%**	**9.4%**	**7.2%**	**23%**

We compare the historical risk levels for the asset classes and the combined portfolios for two dates: December 2007 and April 2001.[16] The results confirm that the MV allocation decreases the risk of the 60/40 asset allocation by roughly 20% relative to the 'traditional' asset allocation across the two periods.

The MSCI MV World Index is the first global benchmark for managed volatility equity strategies. It offers a transparent methodology and is easily replicable. And, because it is constructed starting with the MSCI World Standard index universe it is fully investable and can be the basis for structured index products and exchange traded funds (ETFs).

[16] The Volatility has been calculated based on an exponentially weighted covariance matrix, estimated with a half-life of 36 months.

Summary

Minimum-variance and managed volatility equity strategies have been around since the early 1990s but have recently gained popularity. Since these strategies do not require return forecasts, they may be in some cases more efficient than strategies that trade off expected risk and return. Moreover, new pension and insurance regulations in the US and abroad have led to increased aversion against asset volatility. Higher volatility has increased the focus on managed volatility equity strategies. Thus, the MSCI MV Index would serve as a transparent and relevant benchmark for such strategies.

In the past, most studies of minimum-variance portfolios and strategies have focused on domestic or regional markets. Here, we extend this to a global universe. The MSCI global MV Index shows strong risk adjusted performance compared to a "market" proxy, the MSCI World Index, as well as the long duration FI index. In addition, our analysis of its characteristics confirmed that the MSCI MV World index performance profile is consistent with earlier studies of minimum variance portfolios for US and European markets. The MSCI MV World index experienced approximately 30% lower volatility than the MSCI World Index over the period June 1995 to December 2007. Its performance, measured by Sharpe ratios, was superior relative to the MSCI World Index--0.67 vs 0.45.[17] Its overall excess return (above 1 month T-Bill) was 6.5% compared to 6% for MSCI World Index.

[17] The Sharpe ratios are calculated before transaction costs. Keeping in mind that the turnover for the MV Index was constrained to 10% per semi-annual rebalancing, transaction cost would have no material impact on the reported results.

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