Part 1

Improving equity diversification via industry-wide market segmentation

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Abstract

Over the past decade, traditional equity asset categories have become less effective as a source of diversification benefits. To counter this trend, we advocate a classification scheme based on industry-level equity definitions rather than style and size breakouts. Potential benefits include more stable asset definitions, increased diversification, and potential performance enhancement. We evaluate several schemes of equity market segmentation to analyze the benefits of the industry-level classification.

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Our goal is to assist long-term investors who are aiming to achieve a target wealth (or spending pattern) and who can efficiently rebalance their portfolios over time. Typical examples include: pension plans, university endowments, life insurers, and family offices. We assume that the investor can rebalance her portfolio with modest transaction costs, for instance, in a tax deferred account. For simplicity, we focus on equities assets.

The performance of an asset allocation depends upon the underlying classification scheme. Consequently, what are the desirable characteristics of any splitting of equity securities, such as the U.S. stock market? Firstly, there should be relatively little overlap between securities in each asset category. Otherwise, the investor may be doubling (or tripling) up on the overlapping securities — without regard to the underlying economic conditions. Secondly, the universe of securities should be available for selection. Of course, there will be investors who are restricted from investing in certain securities such as gun manufacturers or tobacco companies, and extra effort is needed in these cases. Thirdly, the asset categories should be stable with respect to their membership. Otherwise, the investor must buy or sell securities for no other reason than a security has entered or left an asset category. There is little economic incentive for these transactions. Next, asset categories should be readily available for historical back testing. For instance, the S&P 500 index has had a long history of performance (returns, volatilities, correlations, etc.). Also, if possible, the category should be investible as a simple index. An investor may wish to avoid active management and take a passive approach, or she may choose to employ the index as a tactical tool. The benefits of investable asset groups are becoming well known, along with the growth of exchange trade funds (ETFs) in these areas. Lastly, for asset-liability management, the asset classification should allow for surplus diversification, say by exclusion of certain categories. This last issue has not been fully developed, but will become increasingly important as the ranks of retired investors grow rapidly. In this paper, we evaluate the properties of the traditional categories (style and size), with reference to the potential benefits of an alternative classification based on industry-level definitions.

Benefits of industry segmentation over style/size segmentation

Portfolio management on long-term investments, such as pension plans or university endowments, are typically conducted in two steps. First, an asset allocation (or better, an asset-liability) study is conducted in order to determine the best capital assigned to a set of asset categories. It involves both defining asset classes and setting the target weights on them. Actual capital assignment step would then be followed. Investors usually choose either passive indices or active funds to meet the goal for each asset class. The first step mostly involves traditional portfolio theories, and the second step rather relies on the decision makers' preference or belief on market characteristics.

When such procedures are adopted, current approaches typically prioritize equity segmentation by style and size. Figure 1 illustrates common breakouts and passive indices of the U.S. stock markets. Stocks are classified from large-cap to small-cap based on their market capitalization, and from growth to value based on their price-to-book ratios and forecasted growth values. Most active equity managers also categorize themselves into one of style/size breakouts. They are expected to provide better performance than the passive benchmarks while constructing their portfolios with corresponding stocks. Since typical performance measures

Style	Benchmark Index
Large core	Russell 1000 (R1000)
Large growth	Russell 1000 growth (R1000G)
Large value	Russell 1000 value (R1000V)
Mid core	Russell mid cap (RMid)
Mid growth	Russell mid cap growth (RMidG)
Mid value	Russell mid cap value (RMidV)
Small core	Russell 2000 (R2000)
Small growth	Russell 2000 growth (R2000G)
Small value	Russell 2000 value (R2000V)

Figure 1 – Typical equity breakouts and corresponding passive indices

for active managers, such as information ratios, which determine their compensation, generally penalize deviations from their benchmarks, their return patterns do not differ much from the corresponding passive indices.

Under these circumstances, the criteria for market segmentations obviously have a large impact on investment performance. Therefore, it is natural to ask whether the current cut of the stock market is good, and, if not, whether any improvements are possible. We have found that industry segmentation possesses benefits over the style/size segmentation in several important aspects, such as consistency, diversification, and potential performance improvement.

Consistent constituents

Undoubtedly, market segmentation should provide consistency on the components over time. Such a property will allow the investors easy tracking on each breakout. More importantly, it may improve investment performance of active funds. Since active funds are generally restricted to constructing their portfolios from stocks only within designated breakouts, if its components change frequently it may force them to conduct unwanted portfolio reconstructions. For instance, when a small-cap stock becomes mid-cap due to its price increment, small-cap active funds are required to sell it, even if the transaction is not desired by the fund managers. Such a forced portfolio adjustment tends to act as a constraint, which often deteriorates investment performance.

In this context, the industry classifications have a clear advantage over the style/size breakouts; firms do not easily change the industries to which they belong, while their sizes and growth perspectives can easily alter. For example, while the technology industry has remained growth-oriented over the past decade, its size has changed a number of times. It shrank from large-cap to small-cap, and then grew back to large-cap. Similarly, the healthcare industry has been classified as large-cap, while its growth perspectives have changed over the last decade. The oil and gas industry has also experienced similar changes over the style/size map. Since the constituents for each industry are relatively fixed over time, it is apparent that style/size classifications provide less consistency on their component listings.

Description	Code	Indices included
Typical style/size breakouts	Typ-SS	R1000, R1000G, R1000V, RMid, RMidG, RMidV, R2000, R2000G, R2000V
Non-overlapping style/size breakouts	NOL-SS	R200G, R200V, RMidG, RMidV, R2000G, R2000V
DataStream level 2 sectors	IND2	10 Industries indices
DataStream level 4 sectors	IND4	38 Industries indices

Figure 2 – Market breakouts of the U.S. stock market for analyses

Diversification effects

One of the most important objectives of market segmentation is to maximize the similarities of stocks within each breakout and dissimilarities across different cuts. It has a critical implication in the context of portfolio management; when each market segment is treated as a single investment vehicle, it can provide better diversification to achieve the objective.

In order to determine whether industry segmentation can provide superior diversification to the style/size segmentation, we introduce several sets of the U.S. stock market sub-indices in Figure 2. Each set in the Figure represents either the style/size- or the industry-classification schemes. Typical style/size breakouts (Typ-SS) consist of nine passive indices in Figure 1, which correspond to the current practical setting of the stock market segmentation. However, it is not a fair cut, since some indices overlap with others: growth and value indices are included in core indices, and Russell Mid Cap by Russell 1000. Thus, we construct non-overlapping style/size breakouts (NOL-SS), whose components do not overlap, while they cover the same proportion of the market (98% of the whole U.S. stock market). Figure 3 provides a graphical illustration of the Frank-Russell index definitions based on component sizes as well as their market capitalizations compared to the whole U.S. market. The other two sets in Figure 2 represent the industry-level segmentations. We adopt the industry classification schemes of Datastream

Services, from level 2 (10 industries) to level 4 (38 industries) (see appendix for the detailed descriptions of Datastream's industry classifications). Note that both Frank-Russell indices and Datastream sectors are capitalization-weighted. In addition, proxies for the whole U.S. market — Russell 3000 and Datastream total U.S. market index — are almost identical; the correlation of the daily returns of the two indices from June 1995 to December 2007 is greater than 0.99.

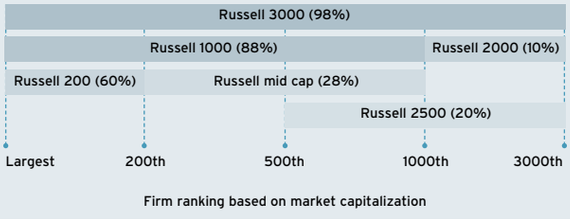

Figure 3 – Graphical illustrations of market capitalizations for Frank-Russell indices.
This figure illustrates rankings on market capitalization of constituents of various Frank-Russell Indices. Percentage in the parenthesis next to the index name represents the relative market capitalization of each index compared to the whole U.S. stock market.

We employ average values of the correlations across different breakouts as the measure of diversification within each market segmentation scheme. Figure 4 depicts the average correlations within different market breakouts for the last twelve years. The values for the style/size classifications are around 0.85, while industry classifications have values of around 0.5. Especially, the average correlations for typical style/size breakouts (Typ-SS) are greater than 0.8, except for 1999 to 2000, which implies that investors have hardly benefited from diversification effects. Roughly, the average correlations for the latter are lower than the former by 0.26 to 0.43. The implication is obvious: industry-level market segmentations could provide better diversification effects for portfolio construction than style/size. These findings corroborate previous works on dominant factors for stock movements. For instance, Kuo and Satchell (2001) show that industry factors have stronger influence on stock return variations than style and size factors. Grinold et al. (1989), Beckers et al. (1992), and Heston and Rouwenhorst (1994) also have reported similar results.

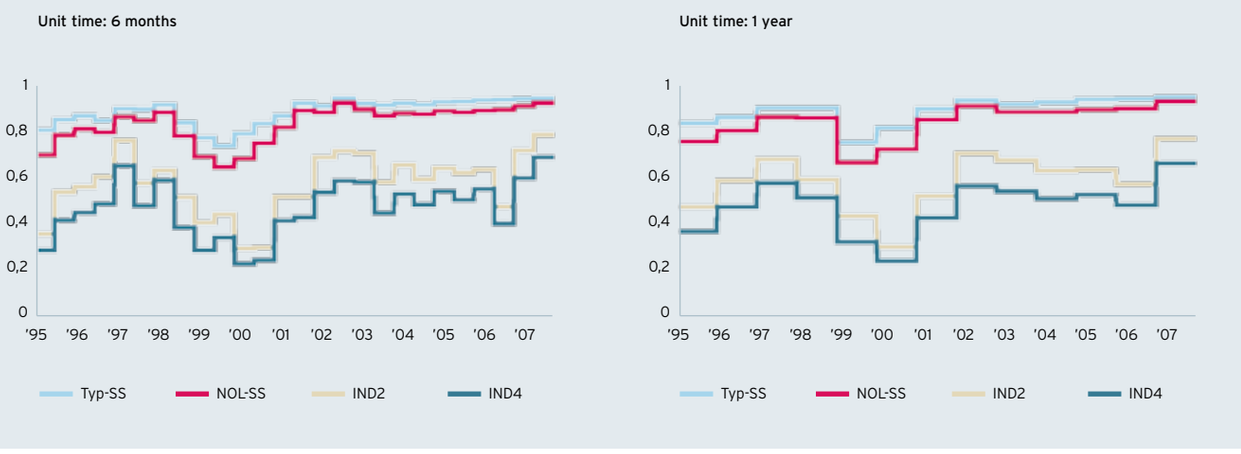

Figure 4 – Average correlations within different market segmentation schemes.
This exhibit illustrates the average correlations for 4 different market breakouts defined in Figure 2. The sample period ranges from June 1995 to December 2007. For each of market segmentations, correlations for all possible index pairs are calculated from daily returns, and then averaged across those pairs. The unit time length for the left figure is 6 months (126 trading days) and 1 year (252 trading days) for the right one.

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	Return	Volatility	Risk adjusted return
Russell 3000 index	11.00%	15.07%	N/A
Fixed mix of typical style breakouts	11.09%	16.33%	-0.42%
Fixed mix of non-overlapping breakouts	10.99%	16.16%	-0.50%
DataStream U.S. market index	11.68%	15.07%	N/A
Fixed mix of datastream level 2 sectors	12.26%	14.48%	1.30%
Fixed mix of datastream level 4 sectors	12.96%	14.83%	1.94%

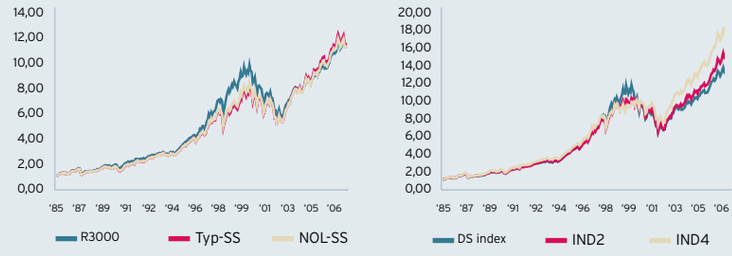

Figure 5 – Investment performance of fixed mix portfolios on different market segmentations.
This figure depicts the investment performance of equal-weighted fixed mix portfolio on the U.S. stock market breakouts from 4 different segmentations defined in Figure 2. The sample period is from 1985 to 2007. All portfolios are rebalanced monthly to achieve the equal weights. Left panel illustrates summary performance measures and right figures show the wealth paths of style/size breakouts (left) and industry breakouts (right).

Pontential improvement in investment performance

For our long-term investor, the overall portfolio return for a multi-period investor can be higher than the performance of a static (single-period) buy-and-hold investor. Earlier works such as Samuelson (1969) and Merton (1969) show that portfolio performance is aided by choosing asset categories possessing relatively independent co-movements. It turns out that the proposed industry-level classification is particularly helpful for multi-period investors due to improved diversification.

To see this, we first construct fixed mix portfolios from four different index sets defined in Figure 2. The fixed mix, which represents multi-period approaches, means that the portfolio is rebalanced at every time point so that component weights remain the same as the initial state, as opposed to the static buy-and-hold, which does not rebalance the portfolio for the entire time period. Hence, the weight on each component might change as constituent prices fluctuate in different proportions. As a primary benefit, the fixed mix strategy improves diversification, leading to superior portfolio returns. Let us assume that there are n stocks whose mean return is $r \in R^n$ and covariance matrix $\Sigma \in R^{nxn}$. Assuming normality, it can be shown that the return of the fixed mix portfolio with weight w follows $N[w^T r + (\Sigma_{i=1\to n} w_i \sigma_i^2)/2 - (\sigma_P^2/2), \sigma_P^2] \equiv N[w^T r + (\Sigma_{i=1\to n} w_i \sigma_i^2)/2 - (w^T \Sigma w/2), w^T \Sigma w]$.

Compared to the traditional Markowitz model, the variance (σ_p^2) is the same, while the expected return contains extra terms, $(\Sigma_i w_i \sigma_i^2 - \sigma_p^2)/2$, which are often referred to as rebalancing gains or volatility pumping. For an easy illustration, let us consider a simple case: all of n stocks have the same expected return (r) and volatility (σ), and the correlation for any given pair is ρ. Also assuming equal weights, rebalancing gain becomes $\frac{1}{2}\{\Sigma_{i=1\to n} 1/n\sigma^2 - (1/n \cdots 1/n)\Sigma(1/n \cdots 1/n)^T\} = [(n-1)\sigma^2(1-\rho)] \div 2n$.

This value is always positive, except when all stock are perfectly correlated. Note that it is a decreasing function of the correlation (ρ). When the fixed mix rule is adopted, better diversification provides higher expected returns [Luenberger (1997), Mulvey et al. (2003) and Mulvey et al. (2007)].

From the results in previous subsection, the benefits of industry diversification can now be readily seen. In Figure 5, we illustrate the performance of monthly rebalanced fixed mix portfolios. Compared to their benchmarks, both of the industry breakouts achieve positive risk adjusted returns (1.30 – 1.94% per year), while style/size breakouts show negative values. Considering the sole change is a different criterion to split the market, the improvements in performance illustrate the importance of appropriate market segmentation.

Fund performance	Best	2nd	3rd	Worst
1993~1994	0.457[b]	0.532[a]	0.484[b]	0.338
1995~1996	0.601[a]	0.344[c]	0.412[b]	0.325
1997~1998	0.510[b]	0.499[b]	0.165	0.224
1999~2000	0.730[a]	0.235	-0.022	-0.258
2001~2002	0.879[a]	0.832[a]	0.803[a]	0.429[b]
2003~2004	0.371[c]	0.405[b]	0.195	0.23
2005~2006	0.765[a]	0.690[a]	0.521[b]	0.301

a, b, c represent significance at the 90%, 95%, and 99%, respectively.

Figure 6 – Correlations of active funds to industry-level momentum strategies
This figure illustrates correlations of excess returns from the long-only industry-level momentum strategy and the large-cap growth funds. The funds are divided into four groups based on their excess returns. The sample period is from 1993 to 2006 and the correlations are evaluated every 2-year sub-period. The long-only industry-level momentum strategy is constructed from the Datastream level 4 sectors.

Another example can be found in Kacperczyk et al. (2005), who argue that the active funds with high concentration in a small number of industries generally have higher investment performance. These findings have been refined by Mulvey and Kim (2008). They have found that the active equity funds in growth and core domains share very similar excess return patterns with the industry-level momentum strategies. Especially, the funds with superior performance show stronger similarities (Figure 6). These results suggest possible investment performance enhancement via industry-level market segmentation.

Conclusions and future directions

We have suggested that an industry-level classification scheme can improve diversification benefits for long-term, multi-period investors. The current style and size breakouts have developed in an ad hoc manner as institutional and individual investors have searched for greater diversification over generic population benchmarks, such as the S&P 500 and Russell 1000. As we have demonstrated, however, the correlations among these categories have increased over time and thus the diversification benefits have become lower. The industry-level classification overcomes several of these difficulties.

What are the next steps? Mostly, we need an increase in ETFs at the industry level. There have been a number of ETFs developed for the higher-level sectors, with a set of focused industry-level products. However, there are a number of industries in which ETFs are now missing. Secondly, we need to encourage active managers to focus on selected industries. Thirdly, there is need for improved benchmarks. The benchmark will need to be changed such as momentum based benchmarks. Lastly, investors should be given a better understanding of the advantages of a multi-period investment perspective.

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Appendix

Level 2 (10 indices)	Level 3 (18 indices)	Level 4 (38 indices)
Oil and gas	Oil and gas	Oil and gas producers; oil Equipment, Services & Distribution
Basic materials	Chemicals Basic resources	Chemicals Forestry and paper; industrial metals; mining
Industrials	Construction and materials Industrial goods and services	Construction and materials Aerospace and defense; general industrials; electronic and electrical equipment; industrial engineering; industrial teleportation; support services
Consumer goods	Automobiles and parts Food and beverage Personal and household goods	Automobiles and parts Beverages; food producers Household goods; leisure goods; personal goods; tobacco
Health care	Health care	Health care equipment and services; pharmaceuticals and biotechnology
Consumer services	Retail Media Travel and leisure	Food and drug retailers; general retailers Media Travel and leisure
Telecommunication	Telecommunication	Fixed line telecommunication; mobile telecommunication
Utilities	Utilities	Electricity; gas, water and multi-utilities
Financials	Banks Insurance Financial Services	Banks Nonlife insurance; life insurance Real estate; general financials; equity investment instruments
Technology	Technology	Software and computer services; technology hardware and equipment

Note: DataStream industry classification is almost identical to Dow-Jones/FTSE ICB (Industry Classification Benchmark).

Figure – Datastream industry classification