

# **Small Cap versus International Stock Indices: On the quest for lower risk and higher returns**

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Risk-return performance studies have yet to draw in their theoretical framing the smaller than small corporations known as micro-cap stocks. They have been conducted without discerning between small and micro-cap stocks. To determine the existence and significance of their risk-return trade-off, this study calls on two benchmarks of this market-cap category. This trade-off is also examined in terms of the effects of foreign stocks on investment portfolios. This study brings in newer indices related to the emerging markets and small-cap international stocks. These domestic and international indices enabled us to re-examine the return- risk link and show that this association is not always true from a systematic risk perspective.

## **Introduction**

Standard models of portfolio choice highlight the risk-return trade-off that investors face as well as the benefits from diversification. Deeper capital markets and greater financial integration around the world have provided investors with new asset classes. Among these, investment opportunities in small publicly-traded firms in both the U.S. and foreign countries, allow investors to break away from traditional fixed income instruments or large public companies that tend to exhibit slower growth.

In this paper, we analyze the performance of several indices that track the performance of firms by market category, geographic location, or both. Index returns are used rather than individual security returns as the latter contain dramatically more noise (Conrad et al., 1991)

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The indices we analyze are the Dow Jones Wilshire U.S. Micro-Cap Index, the Dow Jones Microcap Index, the S&P MidCap 400 and the S&P SmallCap 600 indices, the Morgan Stanley EAFE and EAFE Small Cap indices, the Emerging Markets index, and the World and World Small Cap indices. Not surprisingly, we find that an international small cap index yields the lowest systematic risk and the highest risk-adjusted returns to an investor, relative to the U.S. market represented by the S&P 500 index.

For the purposes of this analysis, we first proceed by separating the indices into two distinct groups: domestic market capitalizations smaller than that of the S&P 500 (small-cap indices thereafter) and international indices. Within the first group, we further divide them into micro-cap, small-cap and mid-cap indices. While the market-cap literature generally points to the outperformance of smaller companies, this research was by and large conducted without discerning between small and micro-cap stocks. As a result, one cannot tell whether this outperformance comes from the small companies or their smaller than small counterparts. Hence, the first guiding thread of the analysis is to determine whether micro-cap indices are distinct enough to merit a category of their own.

A second guiding theme through the study is the difference between domestic and international indices. We answer this question only after submitting our selected domestic benchmark to a rigorous statistical analysis that helps us identify the top performers.

These selected indices are then compared with the international indices along the same dimensions.

Finally, while performance is a key driver in the decision to include securities (or baskets of securities as is the case here) in an overall asset allocation scheme, diversification is a main element as well. For that reason, we hypothesize that a fund tracking an index of small domestic or foreign companies with mostly “unfamiliar” names could not be expected to move in lockstep with the S&P 500, a broad-based market index heavily weighted with large U.S. corporations that often behave as a group and thus do not respond to the same economic conditions as their smaller counterparts. If such is the case, other factors being equal, the combination of these assets should trim the volatility of a strategic investment portfolio without reducing its expected return over time.

The paper is organized as follows, in section 2 we set up a model that represents the problem of an investor that yields theoretically based risk-return measures and shows the gains from diversification; section 3 describes and characterizes the indices that comprise the analysis; in section 4 we apply a set of performance evaluation measures on all the indices; and section 5 concludes and provides a portfolio recommendation based on the indices recent performance.

## I. The Model

This section presents the analytical framework on which the empirical analysis and investment strategies are based. The model concerns the portfolio problem of an investor along with equilibrium conditions that help characterize the relative performance and value of the indices under study. First, we show the conditions under which an investor would like to hold a risky asset in his portfolio, and which amongst several would be preferred. Then, we provide the adjustment factor which would render all assets equally desirable once their co-movement and riskiness are factored in. And finally, we determine the diversification benefits of holding ex-ante similar risk-adjusted indices.

### A The Investor's Problem

Consider an investor who has to allocate his wealth between a risky and a risk-free asset. The risk-free asset yields a predetermined return denoted by  $r_f$ , while the return on the risky asset is characterized by the probability distribution  $F_i(r)$ , whose mean and variance are denoted by  $r_i$  and  $\sigma_i^2$ , respectively. Wealth is normalized to one, so that  $\alpha$  represents the fraction of wealth invested on the risky asset, and  $\beta$  the share of wealth invested on the risk-free asset. This problem is represented by:

$$\max_{\{\alpha, \beta\}} \int u(\alpha r + \beta r_f) dF_i(r) \quad \text{s.t.} \quad \alpha + \beta = 1, \text{ and } \alpha, \beta \geq 0; \quad (1)$$

where the utility function is such that  $u'(\cdot) > 0$  and  $u''(\cdot) \leq 0$ . In this context the investor is risk averse if  $u''(\cdot) < 0$  and risk neutral if  $u''(\cdot) = 0$ . The investor's problem can be alternatively represented as:

$$\max_{\{\alpha\}} U = \int u[\alpha r + (1-\alpha)r_f] dF_i(r) \quad \text{s.t.} \quad \alpha \in [0,1]. \quad (2)$$

Next we show that the investor will wish to hold a positive amount of the risky asset in his portfolio, so long that the expected return on the risky asset is larger than the risk free rate. Taking the derivative of  $U$  with respect to  $\alpha$  and evaluating at  $\alpha = 0$ , we have:

$$U'(0) = \int u'(r_f)(r - r_f) dF_i(r) = u'(r_f)(r_i - r_f). \quad (3)$$

This expression suggests that the utility change from a risk-free portfolio to one that includes both assets is positive as long as the expected return on the risky asset is greater than the risk-free rate. Moreover, this establishes that even a risk-averse investor would be willing to hold a risky portfolio that includes some amount of the risky asset.<sup>1</sup>

The risk-return properties of the investor's portfolio are driven by  $\alpha$ . The larger the share of the risky asset in the portfolio, the more the portfolio mimics the

behavior of the risky asset. In particular, the expected return on the portfolio is a weighted average of the expected return of the risky asset and the risk-free rate. For a given  $\alpha$ , the portfolio's return is represented by:

$$r_\alpha = \int [\alpha r + (1 - \alpha)r_f] dF_i(r) = \alpha r_i + (1 - \alpha)r_f. \quad (4)$$

Similarly, the variance of the portfolio ( $\sigma_\alpha^2$ ) depends on the share of the risky asset on the portfolio. Specifically, it is given by:

$$\sigma_\alpha^2 = \int [\alpha r + (1 - \alpha)r_f - r_\alpha]^2 dF_i(r) = \alpha^2 \sigma_i^2. \quad (5)$$

Hence, the bounds on the return and the standard deviation of the portfolio are  $r_\alpha \in [r_f, r_i]$  and  $\sigma_\alpha \in [0, \sigma_i]$ , respectively. This way, the price of risk, or Sharpe ratio, of the risky asset is:  $p_i = \frac{r_i - r_f}{\sigma_i}$ . This represents the increase in the portfolio's return associated to the increase in risk. When  $\alpha$  is equal to one, the risk and return of the portfolio correspond to those of the risky asset.

## B Market Equilibrium

From a strategy standpoint, if the investor had to choose one among several risky assets to build his portfolio, the one with the highest  $p$  would be strictly preferable to the rest. That is, the one that offers the highest risk-return trade-off.

However, the investor may wish to include more than one risky asset in his portfolio for say, diversification purposes (see below). In such case, the Sharpe ratio would no longer determine the mean-variance frontier of the portfolio, but it would rather be determined by the co-movement of the risky assets' returns. Assets that move in opposite direction would limit the amount of risk in a portfolio, while those that move together could increase the riskiness of the portfolio.

The convention in the literature is to gauge the risk of an asset relative to the market as a whole. This is captured by the *beta* of the asset, which determines whether the risky asset moves with or against the market, and the degree to which it amplifies or reduces market movements. This is referred to as systematic risk. Letting  $(r_m, \sigma_m^2)$  denote the mean and variance of the market, from an equilibrium standpoint, for all risky assets to be held in a portfolio they must yield the same risk-adjusted return. That is, for risky assets  $i$  and  $j$  to be part of the same portfolio it must be the case that

$$r_i - \beta_i(r_m - r_f) = r_j - \beta_j(r_m - r_f) = r_f. \quad (6)$$

Where  $\beta_i(r_m - r_f)$  is referred to as the risk-adjustment factor, which controls for the co-movement of the asset's return with respect to the market. The expression above implies that the equilibrium return of any stock  $i$  should be  $r_i = r_f + \beta_i(r_m - r_f)$ . This expression corresponds to the Capital Asset Pricing Model (CAPM). This model implies that the higher *beta*, the higher the risky asset's return ought to be in order to compensate for the increase in risk. Conversely, assets that decrease risk yield lower return<sup>2</sup>. From a market perspective, assets that temporarily yield abnormal returns are bound to return to the equilibrium return as investors' purchases or sales change returns, all else equal. For instance, a positive abnormal return would attract investors who bid up the price and thus reduce the 'excess' return.

In the empirical analysis, we calculate a general version of the equation above known as the Market Model where  $r_i = \alpha_i + \beta_i r_m + \varepsilon_i$ , where  $\varepsilon_i$  is a random disturbance independent of  $r_m$  and  $\beta_i$  captures the co-movement of asset  $i$  with respect to the market, and  $\alpha_i$  is the mean return of asset  $i$  once the co-movement between the market and the asset is accounted for. This specification imposes less restrictions on how prices (and returns) are set.<sup>3</sup>

### C Diversification

By combining two or more risky assets with similar characteristics, the investor can reduce the volatility of his portfolio once a risk return profile has been chosen. To illustrate this suppose that the investor has decided on the share of his wealth ( $\alpha$ ) that will be allocated on the risky asset  $i$ . Then, consider asset  $j$  which has the same mean and variance as asset  $i$  (i.e.  $\mu_i = \mu_j$ ); although their returns are not perfectly correlated. Any combination of assets  $i$  and  $j$  will exhibit the same mean but lower variance. This is summarized in the following proposition.

*Proposition 1:* Let  $\alpha$  denote the share of an investor's wealth invested in risky assets, and let  $\delta$  represent the fraction allocated to asset  $i$ ; and  $(1 - \delta)$  the share of  $\alpha$  invested in asset  $j$ . Let  $r_i$  and  $r_j$  denote the return on asset  $i$  and  $j$ , respectively. Suppose  $r_i$  and  $r_j$  are jointly distributed random variables with mean  $\bar{r}_i = \bar{r}_j$ ; variance  $\sigma_i^2 = \sigma_j^2$ , and correlation  $\rho_{i,j} \in [-1; 1]$ . Then,

$$\text{var} \{ [\delta r_i + (1 - \delta) r_j] \alpha \} < \text{var}(r_i \alpha). \quad (7)$$

*Proof.* See Appendix A.

This way, through diversification the investor can maintain the same expected return and reduce the volatility of the risky component of his portfolio.

## II. Index Characteristics and Data

The data set used in this study consists of daily price movements for ten indices of which five are U.S indices and the remainder international: The indices we

analyze are: The Dow Jones Select MicroCap Index (DJSM), The Dow Jones Wilshire U.S. Micro-Cap Index (DWMI), S&P SmallCap 600 (S&P 600), S&P MidCap 400 (S&P 400), S&P 500, the MSCI EAFE (EAFE) Index, the MSCI World (WORLD) Index, the MSCI Emerging Market (EM) Index, the MSCI World Small Cap (WORLDSC) Index, and the MSCI EAFE Small Cap (EAFESC) Index.

The idea of using domestic smaller cap stocks in long-term portfolios was validated by the financial literature starting with Banz's (1981) and Reinganum (1981) seminal articles on the effect of company size on performance. Their discovery has spawned several quantitative analyses showing clear differences in the behavior of stocks of varying capitalization, with small cap being the long-term winner relative to large cap. In light of this, several other academic articles as provided by Hawawini and Kleim (1999) in a comprehensive review of the international evidence documented similar results for a number of other countries. They report positive size premia of about 6 to 9 percent per annum for France, Germany, Spain and Switzerland for extended periods before 1989.

Using U.K. data, Levis (1985) explores the size effect and documents an average 6.5 percent annual premium for the smaller decile of U.K. firms over the period January 1958 to December 1982. The attention it attracted led to the launch of the Hoare Govett 1000 and the FTSE Small Companies indices in 1987. Levis' study also provides evidence that smaller U.K. firms appear to have lower betas than larger firms even after adjustment for thin trading. The same result is reported by Poon and Taylor (1991) whose study also shows that U.K. smaller firms' betas are smaller than those of their larger counterparts.

On the other hand, many authors have reported that the significance of the size effect and other reported anomalies depends on the period used for the test. Hawawini and Keim (1995), for example, stressed that as time passes, the significance of many so-called size anomalies disappear. Yet, others have continued to document the importance of managing exposure to market capitalization such as Kothan, Shanken, and Sloan (1995) Loughran (1997) and Reinganum (1999) who have carried on in the tradition of reporting that the value premium is strongest for small-cap firms.<sup>4</sup>

Although the idea has yet to be explored by the academic literature, practitioners' literature has further refined the analysis of capitalization by also stratifying the stock market into micro-cap stocks. This writing has purported that portfolios comprised of micro-cap stocks also outperform those of larger capitalization stocks. Seizing on the rising interest of investors, several index publishers have made indices available using various construction methodologies. The DJSM and the DWMI, the study's gauges of the micro-cap market, are only two of several micro-cap indices put forward by them. By assessing their contribution or lack of to the long term performance of a strategic portfolio, we can also verify the validity of such claims.

Both the Russell 2000 and the S&P 600 indices are recognized gauges of the small-cap market albeit some nuances. Although the Russell 2000 is more comprehensive than the S&P 600 with an additional 1400 stocks, it is also specifically designed to be transparent and all-inclusive without any attempt to screen out stocks with “investability”<sup>5</sup> constraints. In different circumstances this study would have looked favorably on its criteria and would have considered it the better index. In this particular context, however, the S&P 600 is deemed a better choice than the Russell 2000 exactly because of the critique directed toward the former.

Indeed, due to its broader representation of the small-cap market, the Russell 2000 is more likely to incorporate and perhaps even be dominated by the lower percentiles of market capitalization, that precise segment of the market that index providers want to capture within the micro-cap index. Since the focus of the S&P 600 is on “investability”, we expect it to have more stocks on the bigger end of the small-cap spectrum, thereby helping us achieve a better representation of the small-cap market. This supposition appears to be backed by statistics provided by the two index compilers in their respective websites.<sup>6</sup> The market cap range starts at \$300 million for the S&P 600 compared to only \$25 million for the Russell 2000 — a statistic more in line with the size of micro-cap companies. In the absence of an index of “true” small-cap stocks, we can only hope that the reader will agree with our choice of the S&P 600 as a “better” gauge of the small-cap market and thereby espouse our procedure and the results derived from it.

The S&P 400 and the S&P 500 are the other cap-sized indices of U.S. equities. Introduced in 1991, the S&P 400 is a weighted index like other Standard & Poor’s indices. Since its introduction in 1991, it has become a widely used index for mid-sized companies. A mid-cap equity strategy is guided by the belief that U.S. mid-cap stocks also present strong risk-return characteristics as well as diversification benefits that differ considerably from those of both large-caps and small-caps. As to the S&P 500, it’s the study’s selected proxy of the market benchmark. It reflects the risk/return characteristics of the large-cap universe. Considered to be the bellwether for U.S. equities, it holds the stocks of large publicly held companies trading on the New York Exchange and the Nasdaq.

The inclusion of international indices in the study obeys the well-established premise that portfolio diversification with an exclusive investment focus on U.S. stocks is rather myopic given that U.S. equities have now come to represent less than 50 percent of world equities. As such, international investing is now routinely viewed by the finance literature as a straightforward generalization of portfolio selection with a larger menu of assets, and potentially allow for some of the benefits of diversification presented in section 2.3. Indeed, portfolio risk reduction from international diversification remains the subject of many articles, and Madura and O’Brien (1991) provide an excellent review of earlier literature. Of particular note is Grubel’s (1968) article, which demonstrated the mean-variance efficiency of international portfolio diversification. But the most-cited article on the

merits of international diversification was written by Solnik in 1974 and reprinted in 1995. In it, Solnik illustrates how lower levels of portfolio risk are achieved within the internationally diversified portfolios.

The benefits of international diversification have been questioned however by the finance literature in more recent years notably by Siquefield (1996). In his analysis of the 1970-1994 returns he finds that combining a portfolio of the EAFE Index and the S&P 500 doesn't increase expected returns nor decrease the risk of the portfolio. Assuming this is true and considering that the level of capital flows among international markets have by no means weakened since his article was published, we have a priori no reason to doubt that the inclusion of the EAFE Index in our analysis will contradict the literature's downbeat results. This is especially true in light of the fact that the yearly rolling windows used in our study constitute relatively more recent time periods during which globalization has undeniably considerably strengthened. Yet, it's highly plausible that some of the other international indices used in our study could present us with a whole different framework. Bigger diversification benefits could be had from exposure to international small-capitalization stocks and emerging markets stocks as the factors that contribute to their fluctuations could be different from those that stir the movements of their more established counterparts.

International investing requires a benchmark index. As aforementioned, one widely used index of non-U.S. stocks is the MSCI EAFE Index (Morgan Stanley Capital International's Europe, Australasia, and Far East). Designed to measure developed market equity performance, excluding the U.S. and Canada, it consists of 21 developed market country indices.<sup>7</sup> Our second benchmark for the more established economies is the MSCI World (WORLD) Index. The latter incorporates 23 developed market country equity indices including this time the U.S. and Canada.

The emerging market is represented by the MSCI Emerging Market (EM) Index. Indeed, it is often asserted that emerging market stocks share some of the characteristics of securities issued by smaller companies in developed countries as they both face similar borrowing pressures. This addition will certainly present us with the opportunity to test such a statement. This index whose constituents are available to non-domestic investors is comprised of 26 emerging markets who share specific criteria as defined by MSCI.<sup>8</sup>

Last but not the least, the international small-cap market is represented by two indices: the MSCI World Small Cap Index (WORLDSC), which is a free float-adjusted market capitalization index that is designed to measure small-cap equity performance in 23 of the world's developed equity markets and the MSCI EAFE Small Cap Index (EAFESC) representing the small cap segment in 21 developed equity markets outside the U.S. and Canada. MSCI defines as international small caps, the stocks issued by companies with total market capitalization of U.S. \$200-\$1,500 million. These two indices were added to test whether their unique

challenges and risks will show a weak pattern of convergence with U.S. equity markets especially those represented by the S&P 500, thereby providing an investment environment with larger diversification benefits.

All data are provided by the indices' respective compilers. To examine the performance of these index portfolios, their annualized daily price returns are examined over the period beginning January 5, 1999 (date at which the daily compilation of the DJSM and the DWMI began) and ending March 31, 2007. This period is deemed long enough to lend statistical significance to the conclusions. Their behavior is also examined over rolling windows of 1-year performance intervals that add and drop one observation at a time, maintaining the sample size constant. This approach traces the dynamics of the performance measures of the indices, over time, as well as tests for the stability of the results obtained with the whole sample.<sup>9</sup> Note that monthly data for the two micro-cap indices are available over a wider horizon.<sup>10</sup> The difference in frequency is due to the fact that data on the DJSM and the DWMI were first published on only a monthly basis starting August 31, 1992. The other frequencies were added beginning January 5, 1999.

The set of performance measures for the analysis consists of the indices' *alphas*, *betas*, p-values, correlation coefficients and Sharpe ratios, statistics that are thoroughly analyzed in the next section. The Sharpe ratios will allow us to rank them in terms of their risk-adjusted returns whereas beta estimates will indicate which of these indices are most effective in reducing systematic risk. All things considered, this approach provides us with a characterization of the indices, which will help us chart their past and delineate their current position.

### **III. Performance Evaluation**

This section discusses the results of the performance evaluation model set out in section 1 applied to the selected indices, along with other sample statistics. Which index is more attractive based on reported performance is not the question this study seeks to answer. The real issue at hand is to determine whether their risk-return characteristics are different enough to consider them distinct categories of stocks capable of enhancing an investment portfolio. We will also pay special attention to the characteristics of micro-cap and international indices. After all, much has been said about the features of the larger cap categories in the academic literature but to the best of our knowledge hardly any study covered those of the smaller of the small companies. It will be particularly interesting to study them within the context of portfolio diversification.

Given the large amount of statistics and indices, the discussion is organized by first comparing the micro-caps with the U.S. small-cap and mid-cap indices; then, the micro-caps with the international indices; and finally the micro-caps with small-cap international indices for every performance measure.

## **A Sample statistics**

A starting point of particular interest to us is the performance of the two micro-cap indices. They are evaluated in relation to that of the S&P 600 and the S&P 400, our chosen benchmarks of the small- and the mid-cap markets, respectively. All these indices aim at capturing the distinctive nature of U.S. small firms relative to the larger established firms that comprise the S&P 500. To be sure, a significant performance differential, although not sufficient in itself, will go a long way in justifying the view that the micro-cap segment of the market is a distinct market cap category that could independently contend for investors' interest in a well-diversified portfolio.

To examine these indices' performance, annualized daily price returns are examined over the period beginning January 4, 1999 (date at which the daily compilation of the DJSM and the DWMI began) and ending March 31, 2007. As aforementioned, we also examine sub-sample of 1-year length that add and drop one observation at a time (1-year rolling windows), which portrays the evolution of the performance measure under study. Table I presents the statistics and estimates for all indices for the entire sample period.

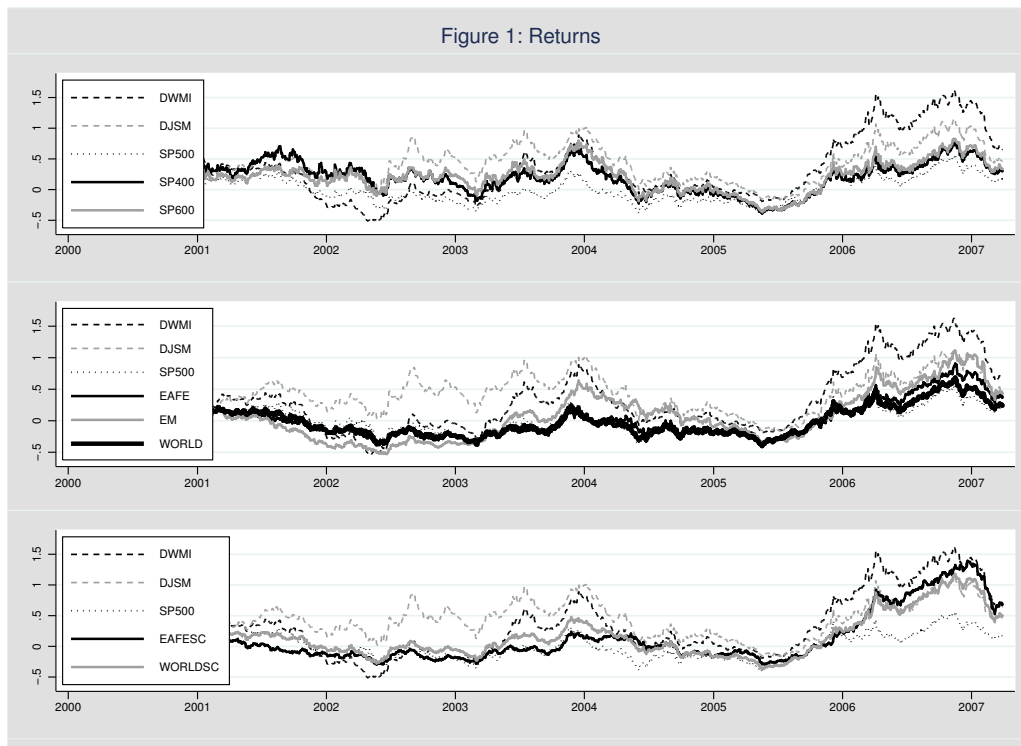
See Table I in appendix

### *Returns*

Our first performance measure is the indices' returns. With 30.36%, the DJSM exhibits the highest average return in relation to the other cap-sized indices including the S&P 400 and the S&P 500. The second highest performance (23.52%) is achieved by the DWMI, the other micro-cap index used in the study. At 20.01%, the performance of the S&P 600 is noticeably less than that of the DJSM or the DWMI.

The performance of the micro-cap indexes especially that of the DJSM, is also evident even when the study's international indices are incorporated. Among this class of indices, the average return of the EM is more than twice that of the EAFE and WORLD indices (22.69% versus 10.78% and 7.59%, respectively) but only slightly higher than that of the WORLDSC (20.26%).

From a dynamic perspective, the 1-year rolling-window returns reported in Figure 1 show that both micro-cap indices have alternated yielding the highest returns, despite the parallel movement of all indices. However, from the bottom panel of Figure 1, we can see that for the most recent rolling windows estimates, the EAFESC has yielded very similar returns as the DWMI. Furthermore, around the beginning of 2006 the DWMI has exhibited larger returns than the DJSM. The analysis also suggests that all indices seem to be recovering from a phase characterized by lower returns.



In regard to the difference in cap categories, when compared to the performance of the DJSM in particular, the performance of the S&P 600 has been lower since the middle of 2002. Overall, when the performance of the two micro-cap indices is compared to the performance of the S&P 600, the DJSM's not only seems to be more significant but also more time enduring. However, since mid 2005, the DWMI has had better performance than both the DJSM and the S&P 600. Together, the performance of the two micro-cap indices is also superior to that of the S&P 400 over the longer time horizons.

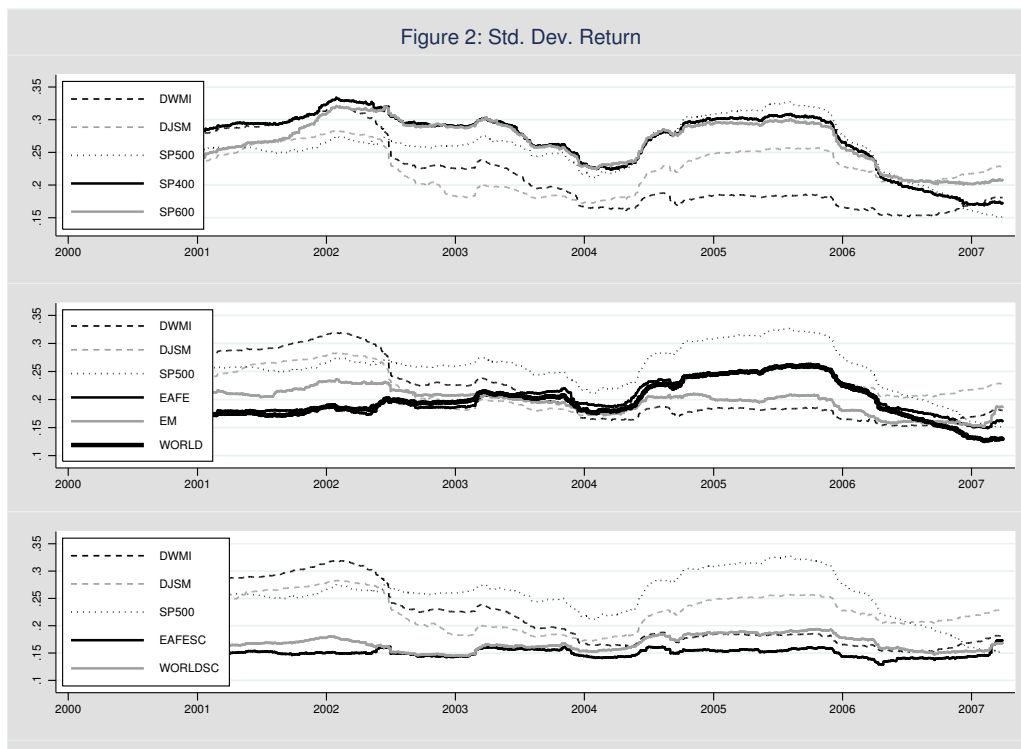
### *Volatility*

In terms of the indices' annualized volatility, measured by the standard deviation of returns, it's the DWMI this time that exhibits a clear superiority over the DJSM and especially over the S&P 600. Interestingly, its volatility is also less than that of the S&P 500. This result is especially surprising considering that the DWMI is comprised of the smallest of the small companies even in relation to the DJSM as indicated in the review of the indices in the first section of the study. As such, one would have rather expected this index to show the highest volatility.

As to the DJSM, its standard deviation is less than that of the S&P 600 with about 2 percent less volatility (0.2131 versus 0.2323). Overall, these basic statistics tend to support the consideration of either the DJSM or the DWMI as a viable market-cap category separate from the small-cap category. Not only their performance seems more significant than that of the S&P 600 but it is also more

time enduring. The micro-caps subdued volatility in relation to the small-cap and mid-cap indices shows resilience by lasting almost throughout the study's time horizons. It is only in the first half of 2006 that the S&P 500, S&P 400, and S&P 600 start exhibiting lower volatility than the DJSM.

The dominance of the micro-cap indices in terms of lower volatility is not as clear when the international indices are brought into the analysis. In fact the WORLDSC and the EAFESC seems to alternate dominance over all of the time windows included in the study (Figure 2). This could have significant repercussion on the study's chosen statistic for risk-adjusted returns.



### *Sharpe ratio*

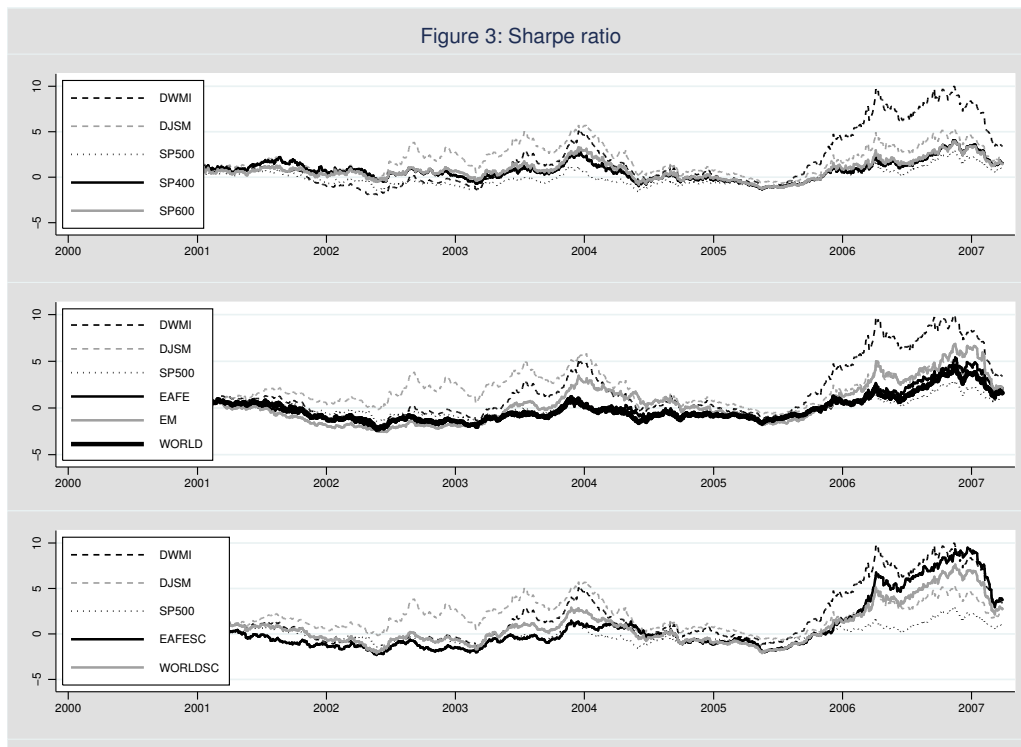
Calculating average index returns and standard deviations does not mean the task is done. Returns must be adjusted for risk before they can be compared meaningfully. The simplest and most popular way to adjust returns for portfolio risk is to compare rates of return with those of other investment funds with similar risk characteristics. But this approach is hardly applicable here since we are evaluating indices representing different market cap categories.

Hence, to further evaluate these equity indices, we next calculate their Sharpe performance ratios, a widely used measure of risk-adjusted returns (see description in section B). Herein, it is a measurement of the index's excess return over U.S. Treasury bills over the sample period adjusted for the index's volatility as measured by the standard deviation. In the simplest case we only need to

ascertain whether they have different Sharpe measures and identify those with the highest ratios. In sum, if the benchmark is the market index, the performance criterion is the Sharpe measure of the other market cap indices versus the benchmark. From these ratios and the results of the regression analysis we will evaluate ahead, we obtain the necessary performance statistics for each index.

As could be predicted from the preliminary risk-return performance analysis of the prior sub-sections, of all the domestic indices the micro-cap indices show by far the highest performance on a risk-adjusted basis over the longer time horizons. For example, the January 1999 to March 2007 period indicates a significant difference in the Sharpe ratios: 1.22 and 1.01 for the DJSM and the DWMI respectively, 0.67 for the S&P 600 and 0.65 for the S&P 400, in relation to a low 0.09 for the market benchmark. When compared to the S&P 600, the risk-adjusted performance of the DJSM in particular is an astounding 82 percent higher (1.22 versus 0.67).

The initial dominance of the DJSM is also true when we bring the international indices into the comparison. It shows by far the highest risk adjusted returns over the longer holding horizons. Though, as shown in Figure 3, in early 2006 the DWMI exhibits higher Sharpe ratios, which mimic those of the EAFESC, beginning in 2007.



The outperformance of the DJSM in terms of risk-adjusted returns prevails over the study's horizon which can be seen in Figure 3. Interestingly enough, since early 2002 corresponds to the rebound in the stock markets, one wonders

whether the bear market of the early 2000s has had more of an adverse impact on the performance of the other market capitalization categories including the small-cap market than on that of the micro-cap market, as the deviation in Sharpe ratios changes markedly. In fact, in terms of their Sharpe ratios, the period corresponding to a bear market has significantly favored the DWMI in particular, an index comprised of the smallest of the small companies as previously mentioned. However, toward the end of the sample, the DJSM's dominance seems to abate as it first starts sharing the limelight with the EAFSC and the EM before being increasingly overtaken by them.

### *Correlation*

A key contribution of the Markowitz diversification strategy is the formulation of an asset's risk in terms of a portfolio of assets rather than in isolation. Markowitz diversification seeks to combine assets in a portfolio with returns that are less than perfectly related, in an effort to lower portfolio risk without sacrificing any of its return. Investment portfolios that satisfy this requirement are called efficient portfolios. This notion is captured by Proposition 1 in section C.

For this purpose, correlation measures are of vital importance to portfolio managers and risk managers alike as they provide them with the means to estimate the diversification level of their asset allocation choice when designing a portfolio. A correlation coefficient approaching the maximum of 1.0 indicates that the two investments constituting the asset mix have consistently moved in the same direction (perfect synchronicity). A correlation coefficient approaching the minimum negative 1.0 indicates that the assets have consistently moved in the opposite direction. Such a correlation offers the maximum advantage from a diversification perspective. Assets with a zero correlation have moved independently. For example, if the DJSM or the DWMI have indeed a low correlation with the other equity classes, then a fund including exchange-traded funds tracking either index would be particularly effective in reducing the overall portfolio's risk.

As to the international indices incorporated in our analysis, special attention will be paid to the small and emerging markets benchmarks. Indeed, it is often asserted that emerging market stocks behave like the securities issued by smaller companies in developed economies as they both face similar borrowing pressures. These correlations will certainly present us with the opportunity to test such a statement. Table II presents the correlation coefficients of daily annualized returns of the aforementioned stock market indices.<sup>11</sup>

### **See Table II in Appendix**

Starting with the daily correlation between the two micro-cap indices and the S&P 500, market returns for these two distinct market cap categories could each be

driven by the arrival of new information with no direct link between them. As high frequency data, daily returns are particularly suited to addressing this issue. At 0.72 and 0.69, the two correlations between the DJSM and the S&P 500 on one hand, and the DWMI and the S&P 500 on the other, infer that, over the last eight years or so, micro-caps have exhibited a moderate level of association with U.S. large caps suggesting the possibility of diversification does exist. To provide the analysis with additional robustness checks, tests using daily data are coupled with both weekly and monthly price return data. The results yield valuable additional insights as we find identical qualitative conclusions.<sup>12</sup> Overall, the tightness of the range as well as the sign pattern attest that the correlations between these two equity classes do not contradict each other, as data frequency is varied and thereby suggests that this relationship is fairly robust.

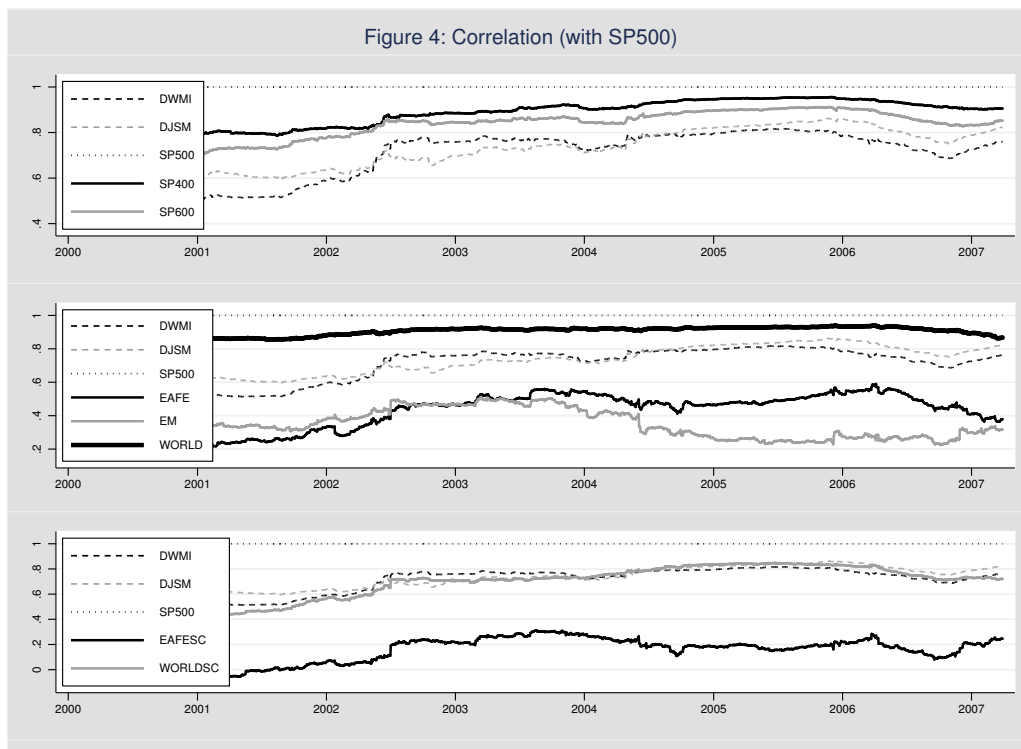
On the other hand, the correlations steadily increase as the comparison moves to mid-cap (0.83 and 0.81 with the DJSM and DWMI, respectively) and then small-cap (0.91 and 0.86) stocks. These results, however, should not come as a surprise since as one moves from a universe of mid-sized and still very liquid stocks to that of less liquid stocks, the similarities with the micro-cap stocks become more evident and should be captured by increasingly higher correlations. Everything being equal, these coefficients indicate that a mix of micro- and large-cap stocks offers investors the best benefits from diversification. This relationship also shows robustness as one varies the data frequency to weekly and monthly price returns from daily.

Correlation coefficients for the study's international indices were also calculated. Of particular interest is the S&P 500's correlation with the EAFESC. It's by far Table II's smallest correlation coefficient at 0.1506. This result is particularly stimulating in light of the reported diminishing diversification benefits from international large-cap equities. On the other hand, with a correlation coefficient of 0.8889 with the S&P 500, the same cannot be said of the MSCI World Index as it appears that diversification benefits from combining the two is almost trivial. Even though this high figure could also have been exacerbated by the inclusion of Canada and the U.S. in the benchmark, this finding seems to epitomize the concerns of the many global investors who have been reevaluating long-held beliefs that international markets provide diversification benefits in a total portfolio context.<sup>13</sup>

The performance of the EAFESC is followed by that of the EM and the EAFE index with 0.3305 and 0.3993, respectively for the most encompassing holding horizon. Although at least twice as high as that of the EAFESC, these two results should not be underrated as they compare favorably with the findings associated with the study's micro-cap indices in relation to the S&P 500.<sup>14</sup>

The three international indices also indicate diversification benefits when combined with our two gauges of the micro-cap markets. Note that the EAFESC maintains its dominance in terms of diversification benefits, especially when

correlated with the DJSM as indicated by its correlation coefficient in Table II (0.3285). Several factors could have potentially prevented the daily prices of their components from tracking those of their U.S. counterparts as predicted including differing accounting practices, the presence of exchange rate risk, country-specific regulations, and perhaps even restrictions on capital flows across national boundaries for some countries. All of these issues seem to add a new dimension to the treatment of portfolio selection; apparently, the combination of the EAFESC with either of the micro-cap indices in a portfolio could also present the globally-minded investor with palpable benefits and, as such, could play a supporting role in a global portfolio.



From a dynamic standpoint, the correlation coefficients of each of the indices with respect to the market benchmark seem even more robust than the other statistics presented so far. Figure 4 confirms that while the micro-caps have lower correlation than the small- and mid-cap indices, the EAFESC exhibits the lowest correlation of all. Furthermore, the EAFE, EM, and EAFESC correlation with respect to the S&P 500 remain under 0.50 for all rolling samples.

## B Market Model

Now we turn to the estimates for the market model presented in section B. The relevant coefficient estimates for our analysis are *beta* and *alpha*. These coefficients capture the co-movement of the indices' returns relative to the market, and the presence, if at all, of abnormal (or subnormal) returns respectively.

### *Beta*

As highlighted before, an often measured aspect of an index' performance is its ability to diversify. An alternative way to measure diversification is by the risk incurred due to market movements. If we continue to assume that the S&P 500 represents the market and the other indices as potential candidates for inclusion in an overall portfolio, then the first step is to determine each index' co-movement with respect to the market.

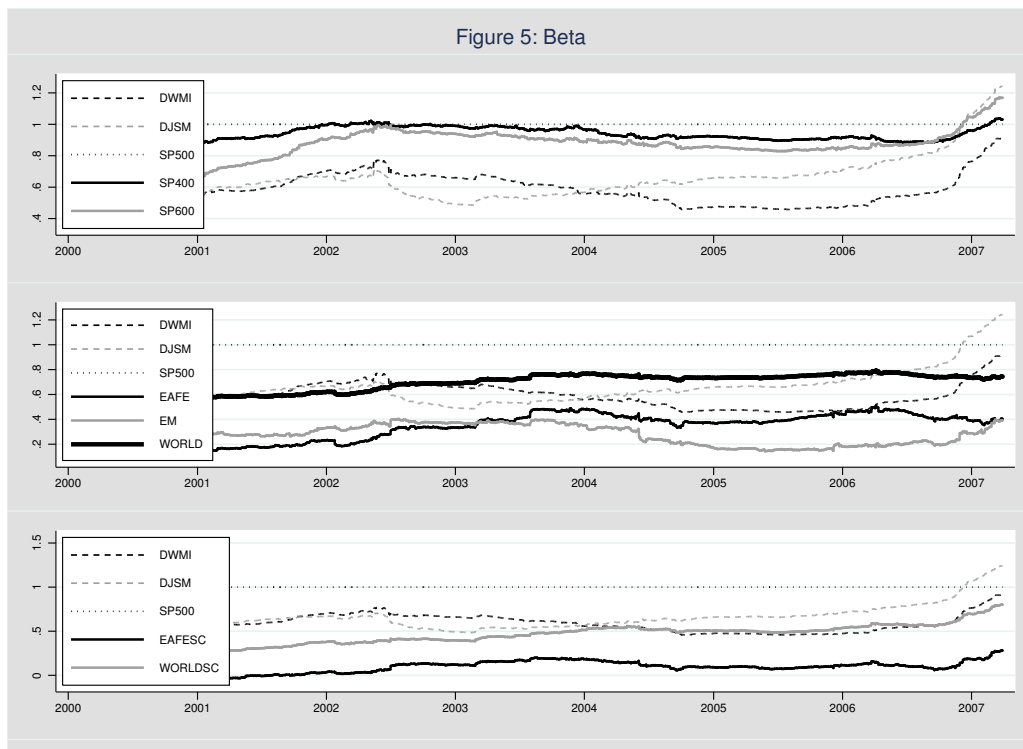
Based on the theoretical model set for the paper, we first determine the systematic risk of these indices relative to the U.S. market. The ensuing estimates for *beta* can be viewed as standardized measures of systematic risk because they relate each individual index covariance to the variance of the market portfolio.<sup>15</sup> Or simply put, they constitute a risk measure that arises from the relationship between the return on the index and the return on the market. *Betas* tell us how the return of an index moves in relation to the market. As such it measures the response of each index to market movements. With this in mind, the index that co-moves the least, or better yet, moves opposite to the market yields the lowest systematic risk. These estimates can be found under Table I's regression statistics.

As our gauge of the market portfolio, by definition *beta* of the S&P 500 is 1.0 as shown in Table I. Hence, if *beta* derived from applying ordinary least squares (OLS) to realized daily returns data is below 1.0, the underlying index shows lower sensitivity to the market and thereby implies less volatility than the market. If OLS estimator for the *beta* coefficient, on the other hand, is above 1.0, this is indicative of higher sensitivity to the market on the part of the index. From a portfolio diversification perspective, a beta that is lower than 1.0 is the desired outcome as it reduces the overall portfolio's systematic risk. If such is the case, then a larger proportion of the index in the combined portfolio would be called for.

The classical Capital Asset Pricing Model (CAPM) hypothesis asserting that market betas completely explain expected returns has given rise to a heated discussion in the academic literature. Among the articles questioning the logic of the CAPM by eliciting beliefs that the relation between average return and beta is in fact weak are those written by Black, Jensen and Scholes (1972), Fama and French (1992, 2004) and Chan and Lakonishok (1993). This, in turn, has prompted the financial press to announce that "beta is dead. Others, on the other hand, have doubted the stationarity of beta claiming that it moves randomly through time. The nonstationarity of beta has been suggested among others by Blume as early as 1975 and more recently by Asgharian (2000) and Goetzmann et al (2001). The violation of the assumption of stable variance by a shifting beta clearly means that the benefits of diversification are not constant.

The evidence from our sample of data doesn't confirm the failure of the CAPM as it doesn't support the notion that "beta is dead" but, on the other hand, it

somewhat challenges the stability of beta, especially for domestic indices. Starting with the first assertion, our findings indicate that all the estimates for *beta* as shown in Table I are less than one and significant at least at the 95 percent confidence level, thereby indicating that market risk is effectively reduced when these indices are combined with our selected proxy of the market benchmark. The results associated with the micro-cap indices in particular are highly favorable in both size and significance of the *beta* estimates, hence substantiating prior findings that began establishing these two benchmarks as a legitimate market cap category, particularly relative to the small- and mid-cap asset categories. Of the two micro-cap indices, the DWMI has the lowest beta at 0.6137, followed by the DJSM at 0.7236 compared with 0.9030 for the S&P 600 and 0.9438 for the S&P 400. As an illustration, the results associated with the micro-cap indices indicate that the DWMI tends to move about 39% less than the market (as represented by the S&P 500) whereas the DJSM moves 28% less than the market.



The dynamics of beta for the small cap indices in our sample are also shown in Figure 5. In particular, the chart displays the variation of the systematic movement of the index relative to the market over time. It suggests that DWMI has provided the least systematic risk for this index class. The chart also shows that international indices fare even better than domestic indices at reducing systematic risk. Special attention should be paid to the EAFESC in particular which exhibits the lowest *beta* of all the indices included in the study followed by EM and EAFE.

One must however be somewhat cautious in interpreting these results as more extensive testing of the stability of beta must be conducted. In our sample of rolling observations, Figure 5 also indicates a common trend across indices towards larger *betas* with respect to the market in the more recent periods. It shows the micro-caps' *beta* drifting upward since 2005. Yet, although the same pattern for the beta estimates of the EM, EAFESC, and WORLDSC is also noticeable since late 2006, they remain far below one even for the most recent time horizons. The consistency of their results throughout the moving time horizons included in the study, show that international indices overall and the EAFESC in particular are more capable than domestic indices of reducing systematic risk when combined with the market portfolio.

### *Alpha*

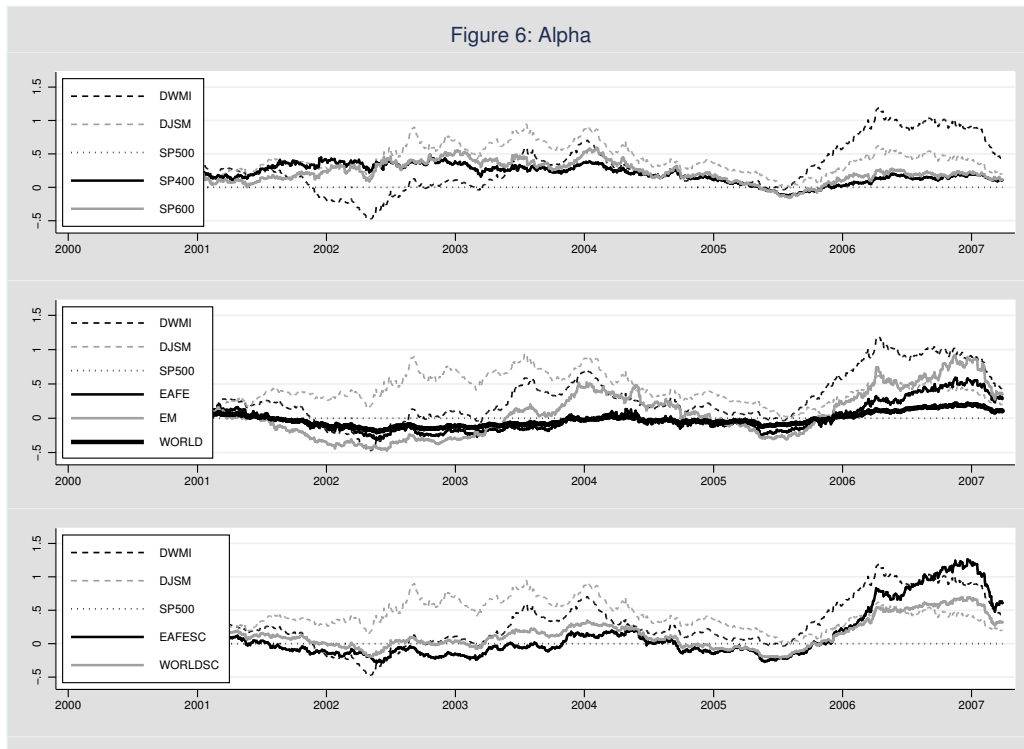
According to our market model, funds' returns consist of two components: a part that is attributable to their exposure to systematic risk, commonly referred as *beta* as previously discussed, and a so-called part generated by *alpha* which cannot be explained by the funds exposure to systematic risk.

This model implies that superior performance requires a positive *alpha* and, as such, the latter is also an important performance measure. A positive *alpha* ( $\alpha_t > 0$ ) within the study's context means that the index has earned a persistent average rate of return over a sampled period that is independent of the index's level of systematic risk. This represents a superior performance on the part of the index. This index's *alpha* will be negative,  $\alpha_t < 0$ , over that sampled period if, on the other hand, the stocks comprising the index are on average yielding negative returns independently of the market movements. This means that this index has performed poorly. If an index's *alpha* is equal to zero ( $\alpha_t = 0$ ), then the index is not yielding either abnormal or subnormal returns relative the market.

The *alpha* estimates from our simple linear regressions are used to evaluate the investment performance of each of the indices included in the study. The study's corollary is that if all the *alphas* turn out to be zero, then the benefit from mixing the S&P 500 with the other indices will come from a reduction in the systematic risk, which even in itself remains a positive outcome for a portfolio manager. If, on the other hand, they happen to be different from zero, we should not expect these *alpha* estimates to be excessively high as the sample from which they are derived represent benchmarks rather than actively managed portfolios.

From Table I, we can observe that most *alphas* are positive and significantly different from zero. The DJSM, DWMI, EM and EAFESC, in particular, have consistently generated *alpha*.<sup>16</sup> At first, these results came as surprise to us in view of the fact that these are indices not actively managed funds. But on the other hand, this could mean that, as information become more and more scarce, one should expect progressively more mispriced securities in the lower market-cap segments of the market, which, in turn translates into alpha opportunities for the aforementioned indices.

Across sub-samples, beginning in mid 2005, Figure 6 shows that all indices seem to exhibit a hump shape in alpha that continues through 2007. It is necessary to point out that the statistical significance of the estimates for *alpha* varies across samples. In appendix B, we provide the same set of statistics as in Table I for different sub-samples, but based this time on weekly and monthly annualized returns. It shows that the results are fairly robust across data frequencies.



The finance literature has often questioned the degree to which securities are fairly priced in smaller capitalization equities and equities from the emerging markets given information that is known about their issuers. It has suggested that these markets are potential sources of excess returns on the grounds that they might be less efficient than the markets for large-capitalization stocks. In essence, this study reaches the same conclusions. Perhaps, either the alpha we are referring to is spurious, herein resulting from the imperfect specification of the chosen model (regression against the S&P 500) and thereby should take this result with a grain of salt or, which is more likely, ensuing from the “survivorship bias” and or “self-selection bias” that often characterize index construction. In this case the survivorship bias results from periodically removing unsuccessful companies from the index (only their successful counterparts remain) whereas self-selection bias causes the latter to be affected by the set of selection strategies used by the index provider in the process of compiling the index; both creating a positive bias since skewing the index toward a set of “performing” stocks on a going-forward basis.

### *Adjusted Alpha*

Note that one cannot use alpha to rank performance of different assets. Although it does have asset-pricing implications and it measure excess returns empirically, it is not suitable for ranking purposes unless it is divided by *beta* to also account for the level of systematic risk.<sup>17</sup> For example, in Table I, EAFESC and EM have roughly the same alpha over the sample period. It cannot be concluded, however, that these two indices have performed equally well simply because their *alphas* are similar. This is because EM has essentially three times the level of systematic risk of EAFESC (0.3030 vs 0.1086) and as such its adjusted *alpha* is in effect one third of EAFESC (0.6738 vs 1.7913). The micro-caps exhibit the third and fourth highest-adjusted *alphas* following the EAFESC and the WORLDSC.

## **IV. Concluding Remarks**

This paper analyzes the dynamic diversification and returns properties of a set of domestic and international indices as components of an overall investment strategy. We rank these indices according to their risk adjusted returns, their ability to reduce systematic risk, the diversification benefits they contribute to the portfolio, as well as their potential to generate alpha.

Starting with U.S. indices, by establishing the dominance of the DWMI and the DJSM this study has in effect outlined the importance of the micro-cap market for investment strategies based on the short-, medium- and long-term periods. As such, this finding should be considered as bridging an important void left open by the academic literature as it has showed little interest into this segment of the market. In comparison to the S&P 600 and the S&P 400, they exhibit greater potential returns while contributing more effectively to a reduction in systematic risk.

Also, current market inefficiencies unique to the micro-cap space create an environment with the potential to generate some *alpha*. Clearly, the listed benefits of this asset class are not separated from its unique challenges ranging from liquidity and business risks to corporate governance and transparency. But the bottom-up approach and constant reevaluation of the content of the micro-cap indices on the part of their compilers in terms of weeding out companies that are more likely to succumb to adverse economic conditions or suffer from limited access to capital markets, particularly at periods of tight credit conditions are two of the best known ways to date to mitigate these risks. Our overall portfolio strategy also includes international indices. Our findings indicate that our gauges of international small-cap stocks (EAFESC) and emerging markets stocks (EM) offer the largest diversification benefit and risk-adjusted returns.

Overall, our proxies of U.S. micro-cap, international small-cap and emerging market stocks give U.S. investors four interrelated reasons for considering

investments linked to these indices. First, they present them with opportunities to broaden their horizons as ignoring these market categories considerably reduce their choices. Second, our findings show their risk-adjusted returns are substantially higher than those exhibited by the small- (excluding micro-caps), medium- and large-cap indices. Third, they also provide risk reduction via diversification in terms of favorable correlations with the S&P 500 as a core portfolio and also by means of a decrease in systematic risk via-à-vis the same benchmark. Intuitively, smaller firms tend to grow faster and are less subject to U.S. aggregate shocks. Fourth, but not least, because of the nature of the stocks comprising these indices, they also present investors with compelling potential returns in terms of *alpha*. Surprisingly, their volatility is also much lower than expected. It is in fact in line with that of the S&P 500. These results, which were found to be robust across the various holding horizons considered in our study, show that indices of less established firms and emerging market firms can exhibit after all higher returns and lower risks.

Surely, these results should be treated with some caution as the 1999-2007 time-period examined is relatively short and assesses past performance. It is therefore possible the results are time-period specific and do not fairly represent a longer historical record. Hence, it's important that these findings are periodically reassessed as more data become available. Future research should also consider the introduction of other micro-cap, international small-cap and emerging markets indices as other index compilers make them available. After all, their providers often pursue different methodologies when compiling them. The inevitable ensuing differences in both the content of the index and the weights allocated to its constituents could very well have an impact on its performance.

## Appendix A

This appendix proves Proposition 1 (by contradiction).

Suppose  $\text{var}\{\delta r_i + (1 - \delta)r_j\} \geq \text{var}(r_i)$ .

Then,

$$\alpha^2 \text{var}[\delta r_i + (1 - \delta)r_j] \geq \alpha^2 \text{var}(r_i)$$

$$\delta^2 \text{var}(r_i) + (1 - \delta)^2 \text{var}(r_j) + 2\delta(1 - \delta)\text{cov}(r_i, r_j) \geq \text{var}(r_i)$$

$$\delta^2 \text{var}(r_i) + (1 - 2\delta + \delta^2) \text{var}(r_j) + 2\delta(1 - \delta)\text{cov}(r_i, r_j) \geq \text{var}(r_i)$$

$$(\delta^2 + 1 - 2\delta + \delta^2 - 1) \text{var}(r_i) + 2\delta(1 - \delta)\text{cov}(r_i, r_j) \geq 0$$

$$2(\delta^2 - \delta) \text{var}(r_i) + 2\delta(1 - \delta)\text{cov}(r_i, r_j) \geq 0$$

$$(\delta^2 - \delta) \text{var}(r_i) + \delta(1 - \delta)\text{cov}(r_i, r_j) \geq 0$$

$$\delta^2 \text{var}(r_i) - \delta \text{var}(r_i) + \delta(1 - \delta)\text{cov}(r_i, r_j) \geq 0$$

$$\delta \text{var}(r_i) - \text{var}(r_i) + (1 - \delta)\text{cov}(r_i, r_j) \geq 0$$

$$(1 - \delta)\text{cov}(r_i, r_j) \geq (1 - \delta) \text{var}(r_i)$$

$$\text{cov}(r_i, r_j) \geq \text{var}(r_i)$$

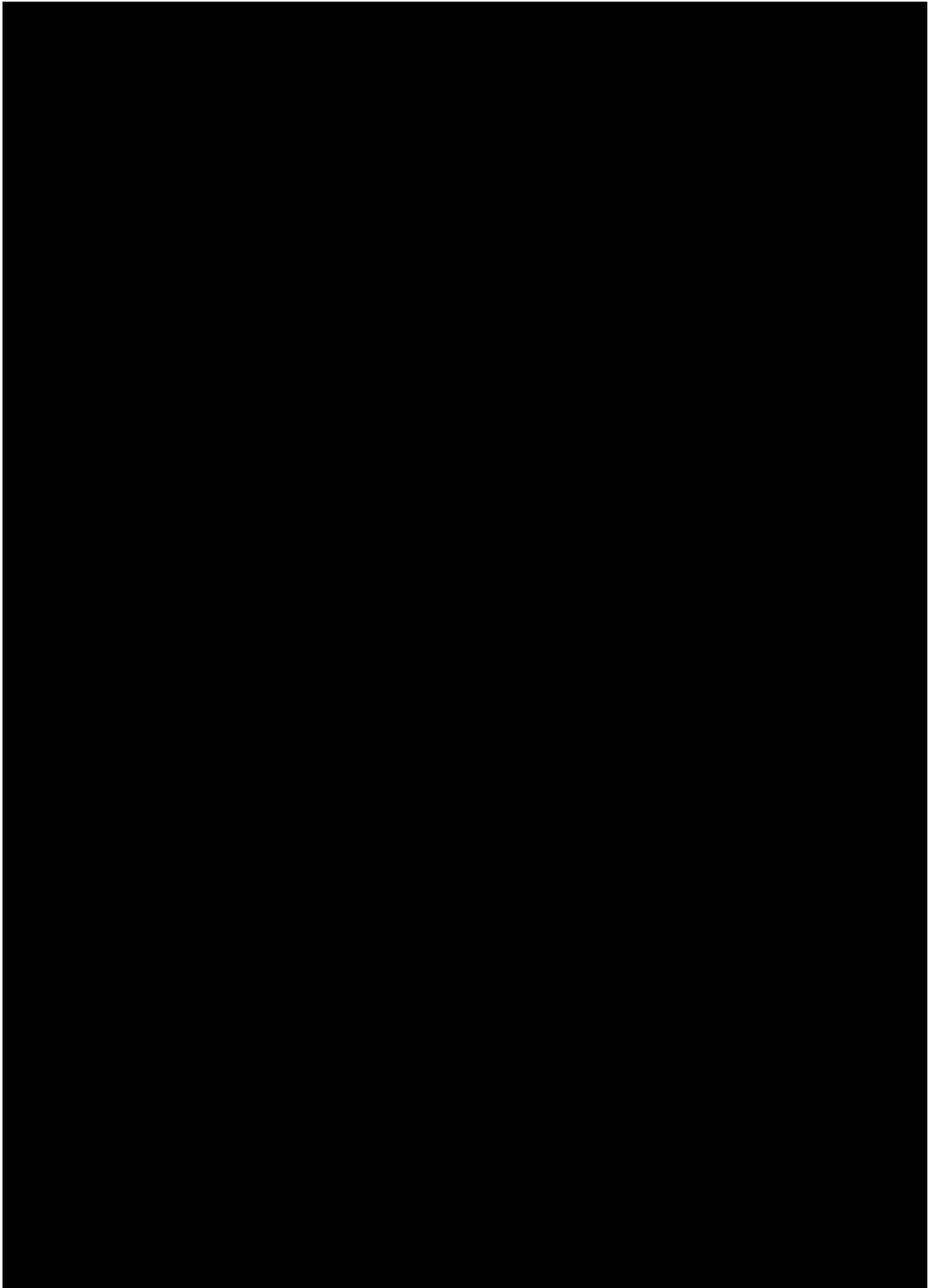
$$\rho_{i,j} \sigma_i \sigma_j \geq \text{var}(r_i)$$

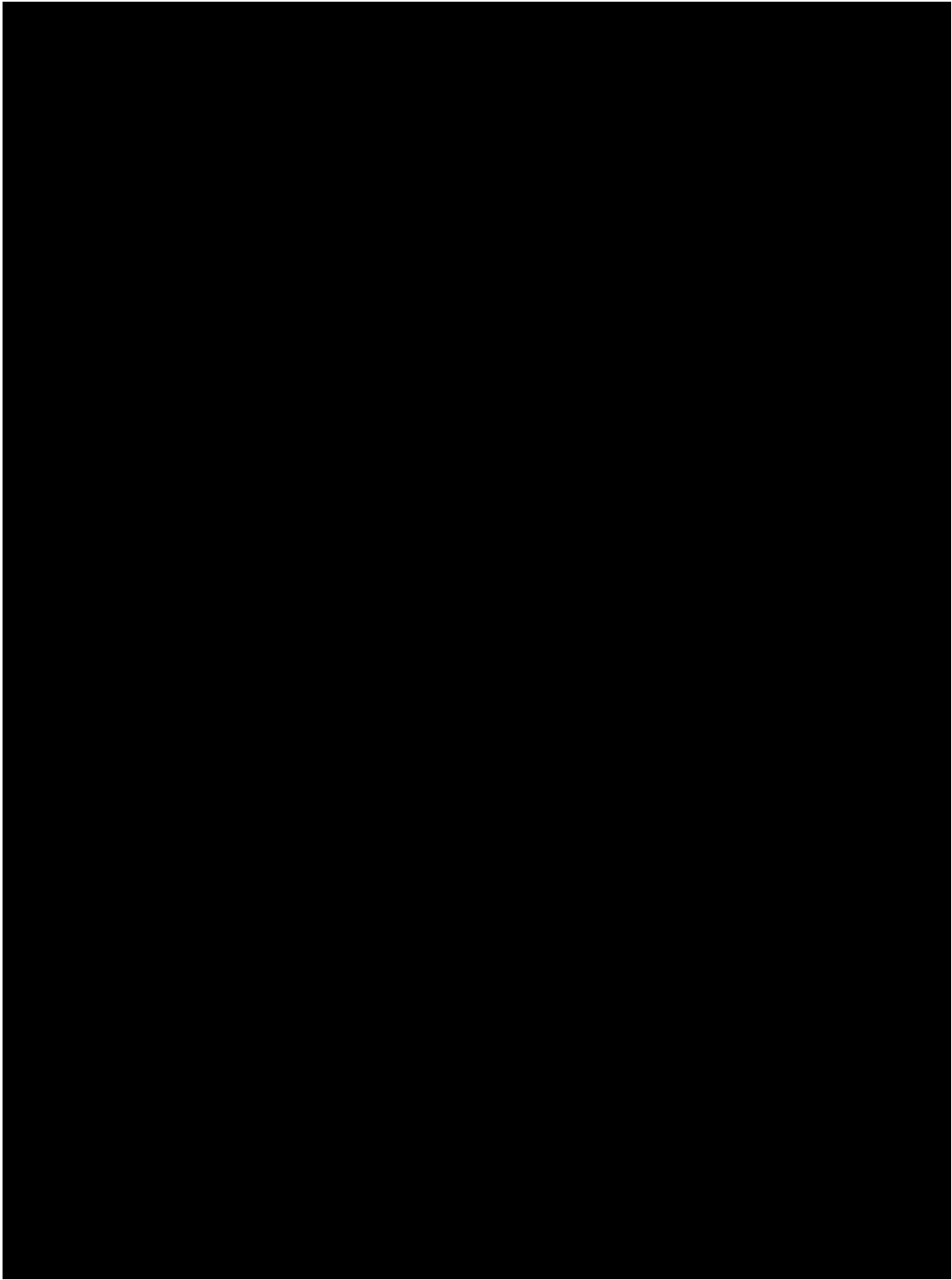
$$\rho_{i,j} \text{var}(r_j) \geq \text{var}(r_i)$$

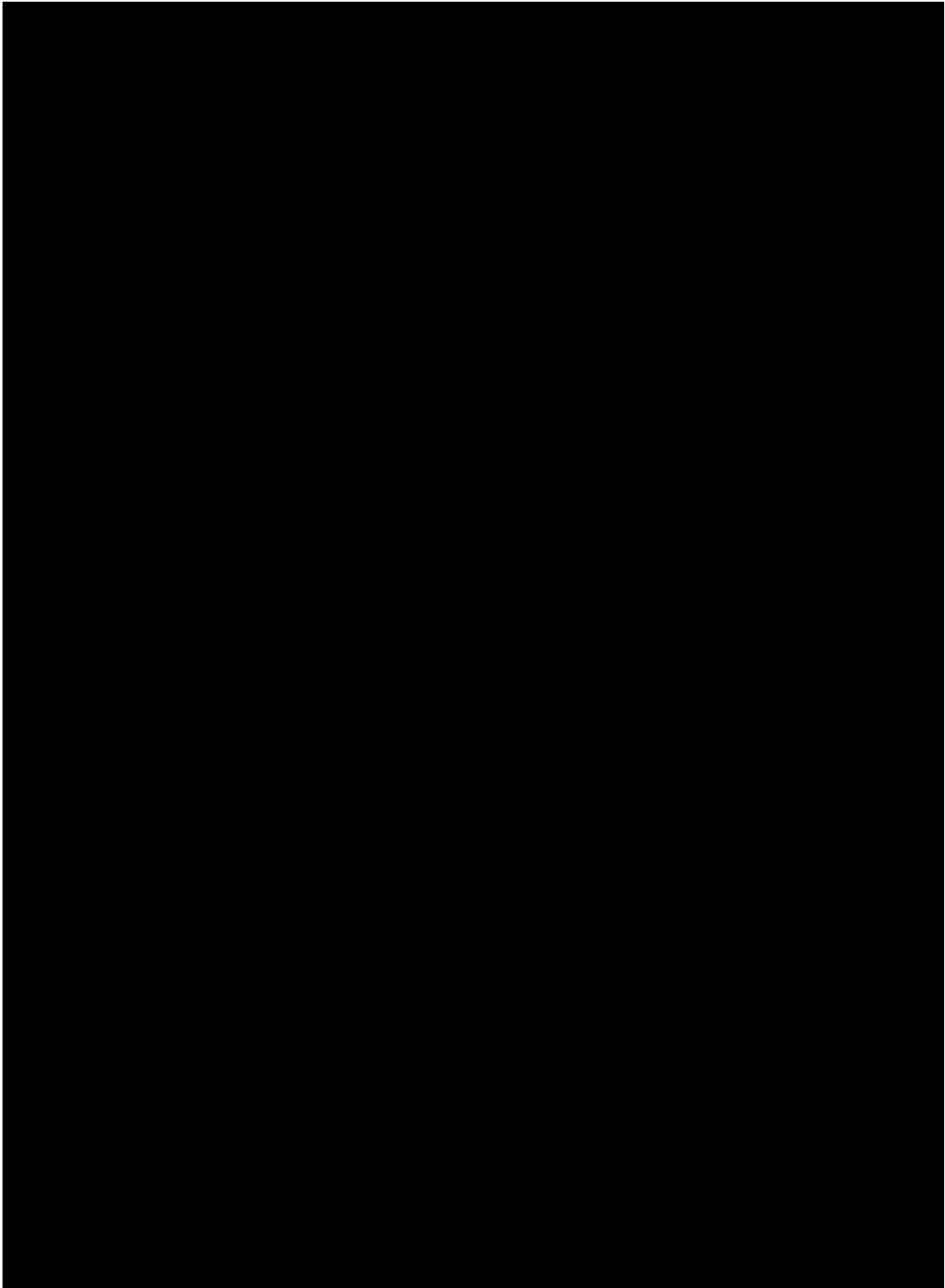
$$\rho_{i,j} \geq 1 \text{ contradicts } \rho_{i,j} \in [-1; 1].$$

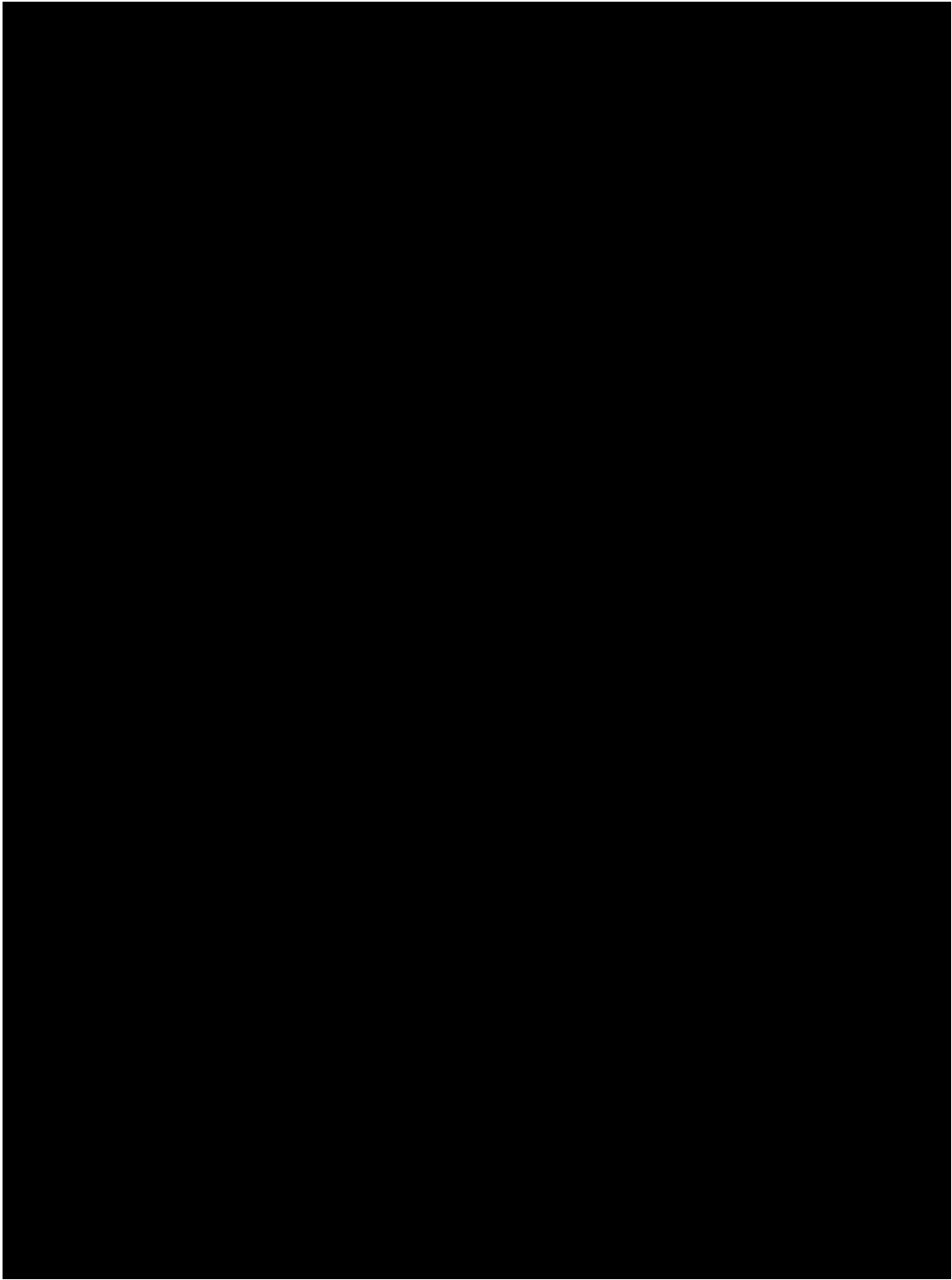
## Appendix B

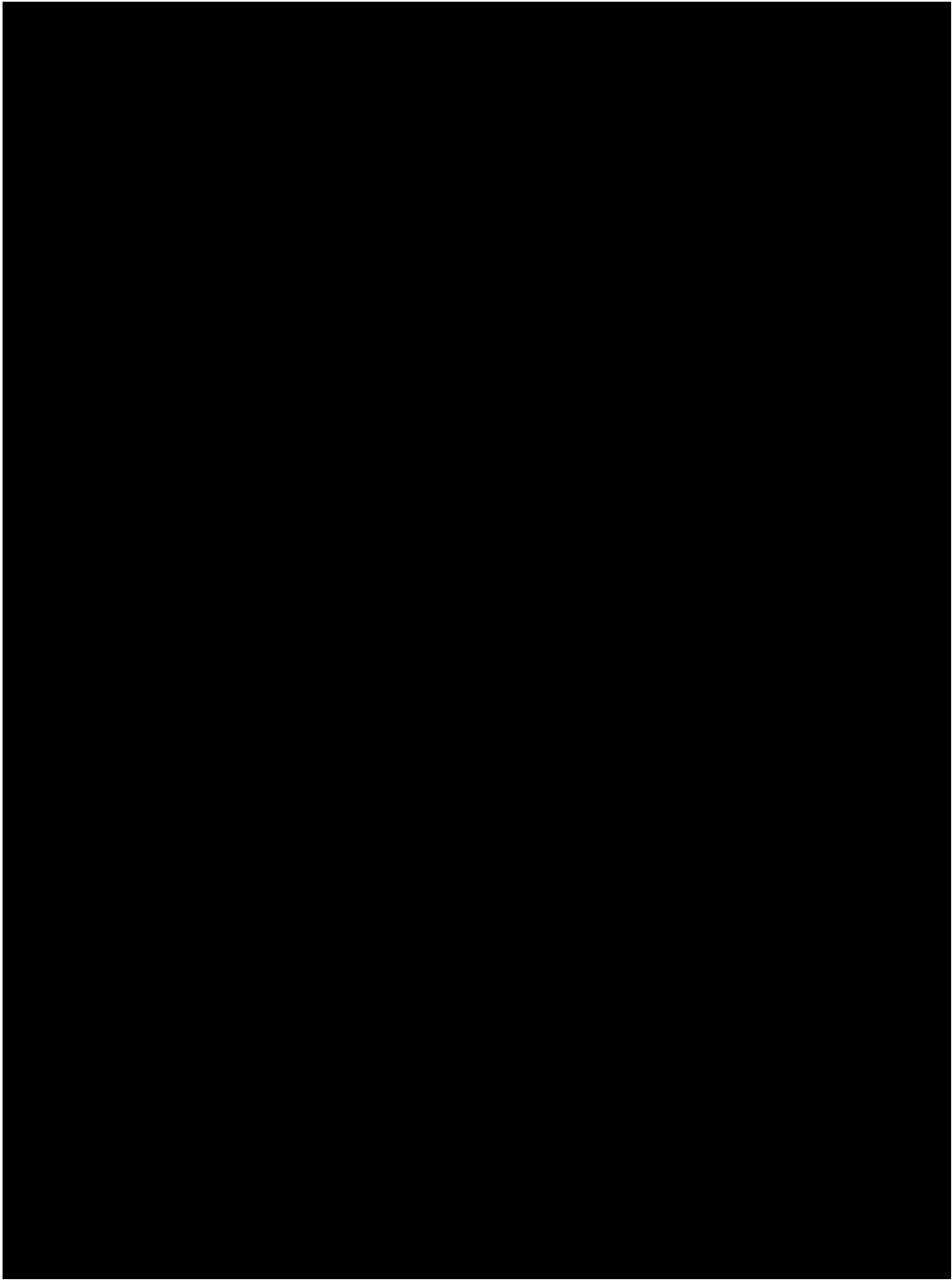
This appendix compiles a set of alternative statistics based on yearly decreasing sample sizes that converge to March 31<sup>st</sup> of 2007.

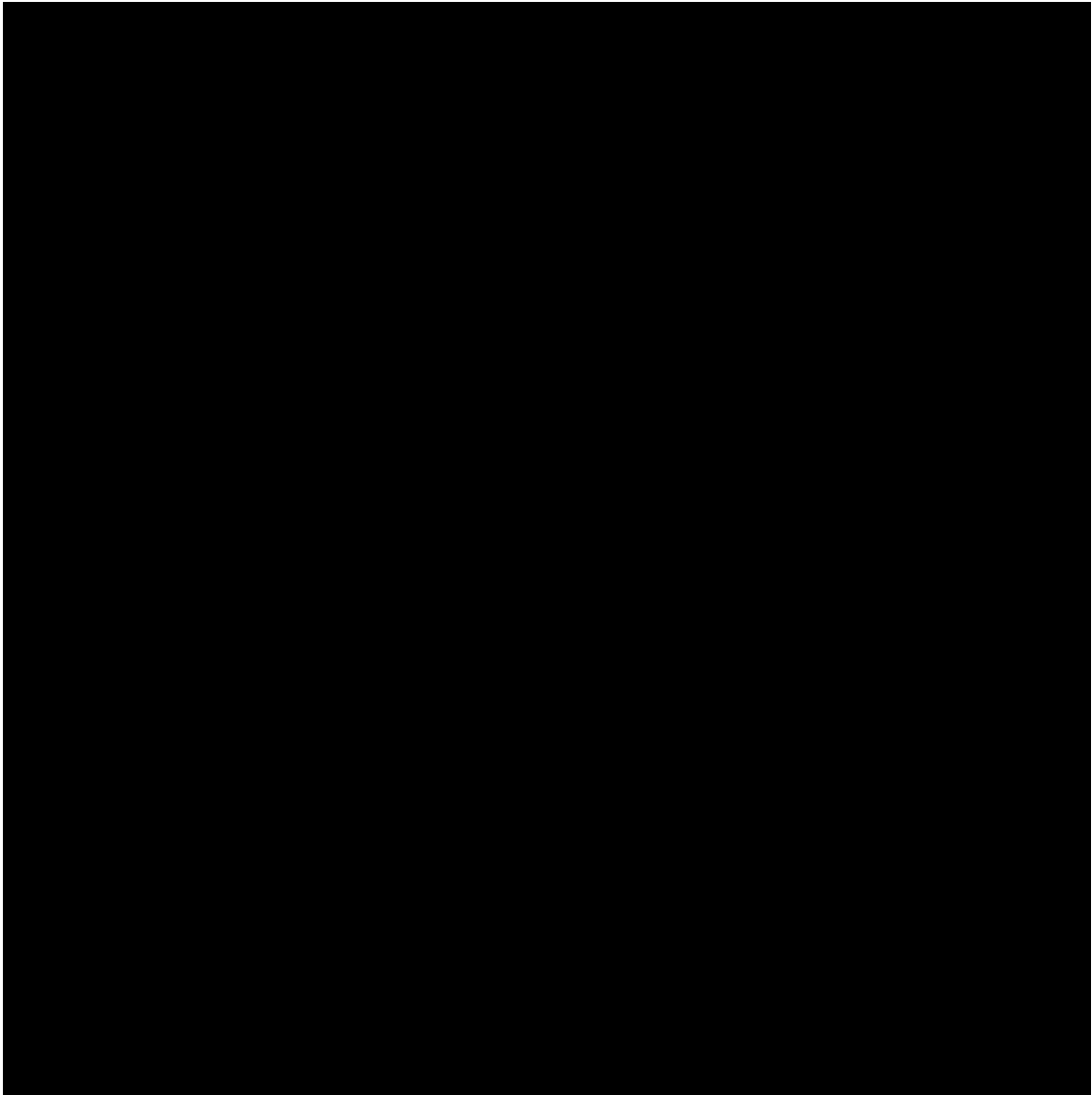


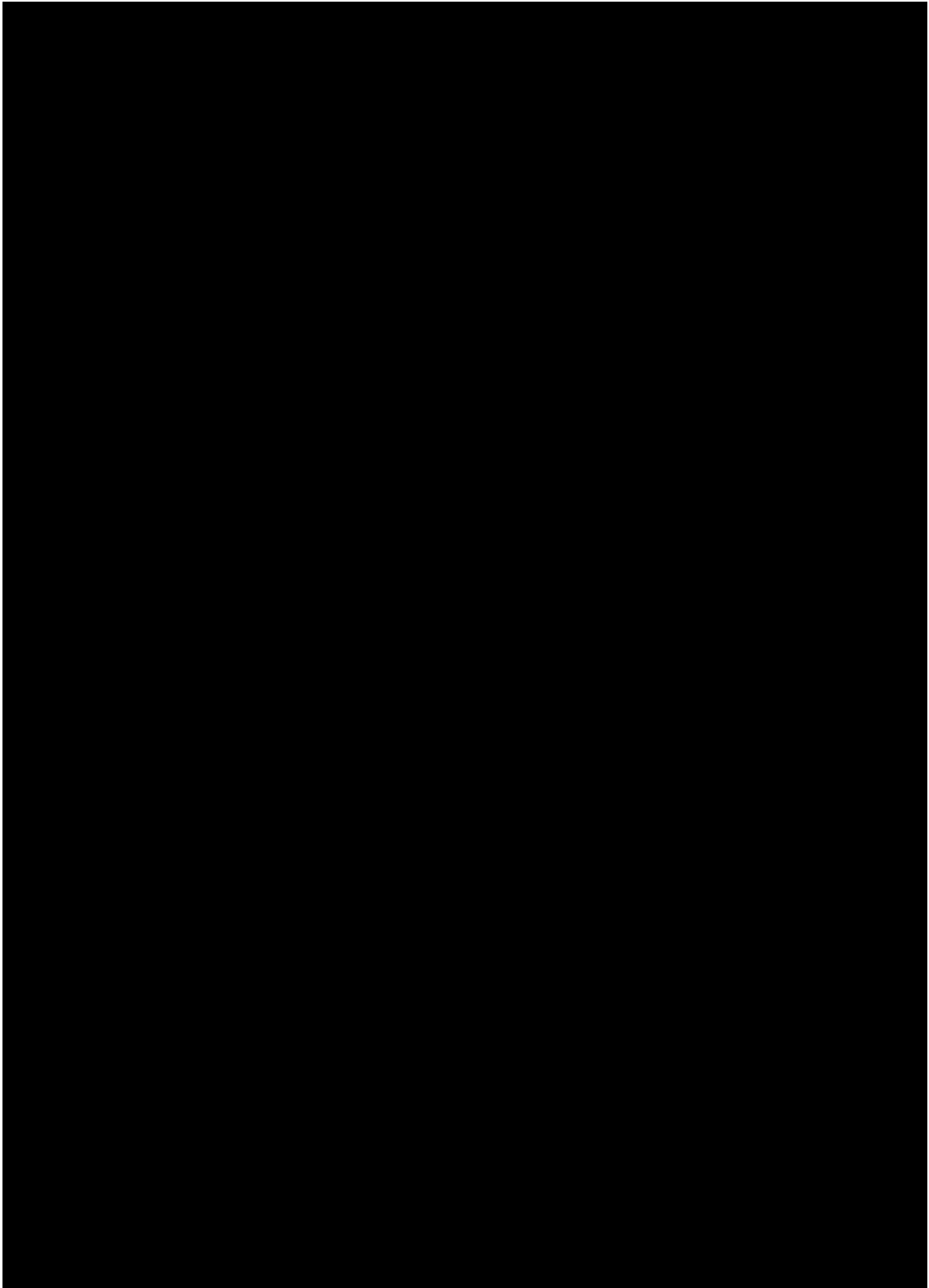


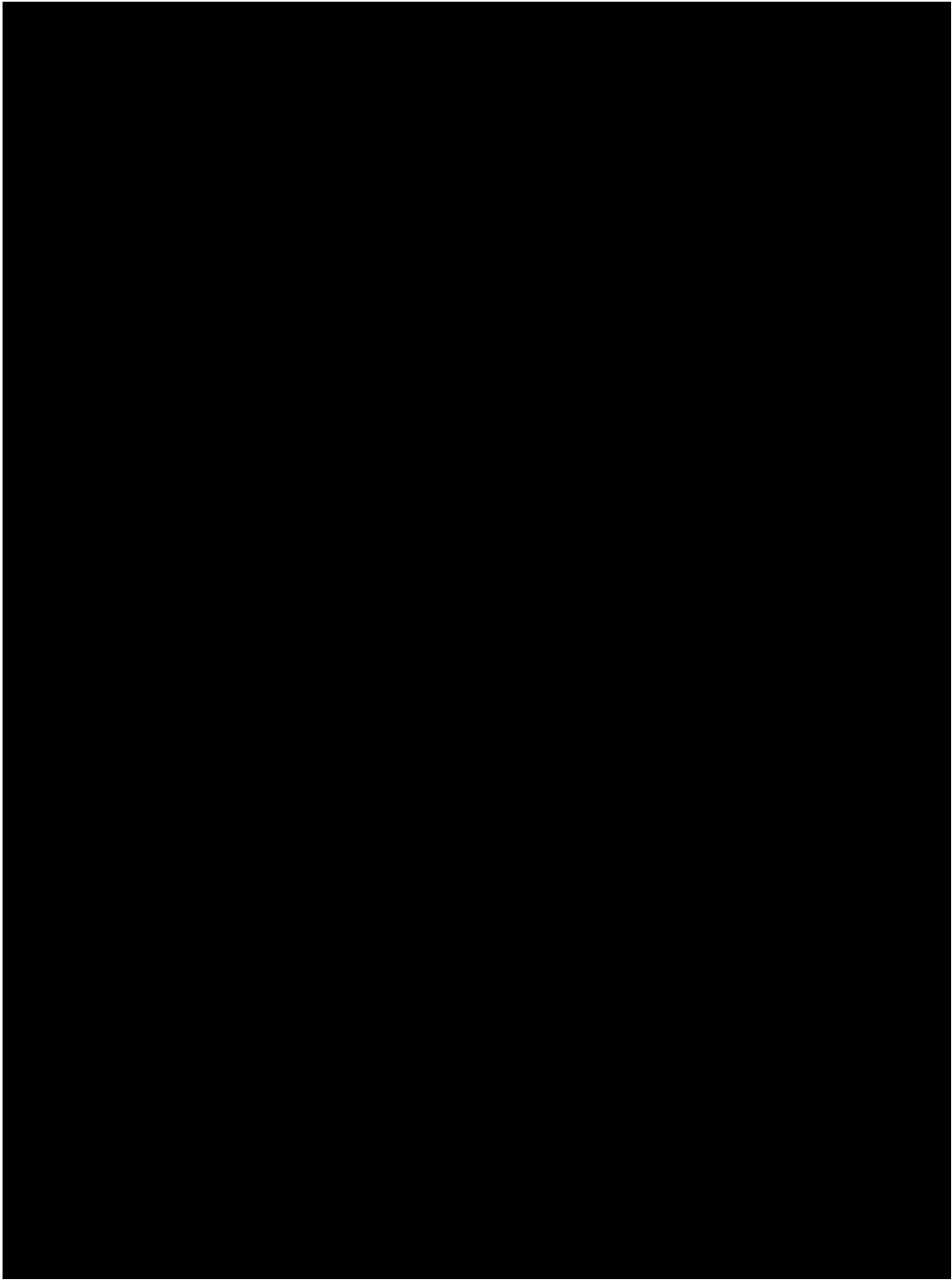




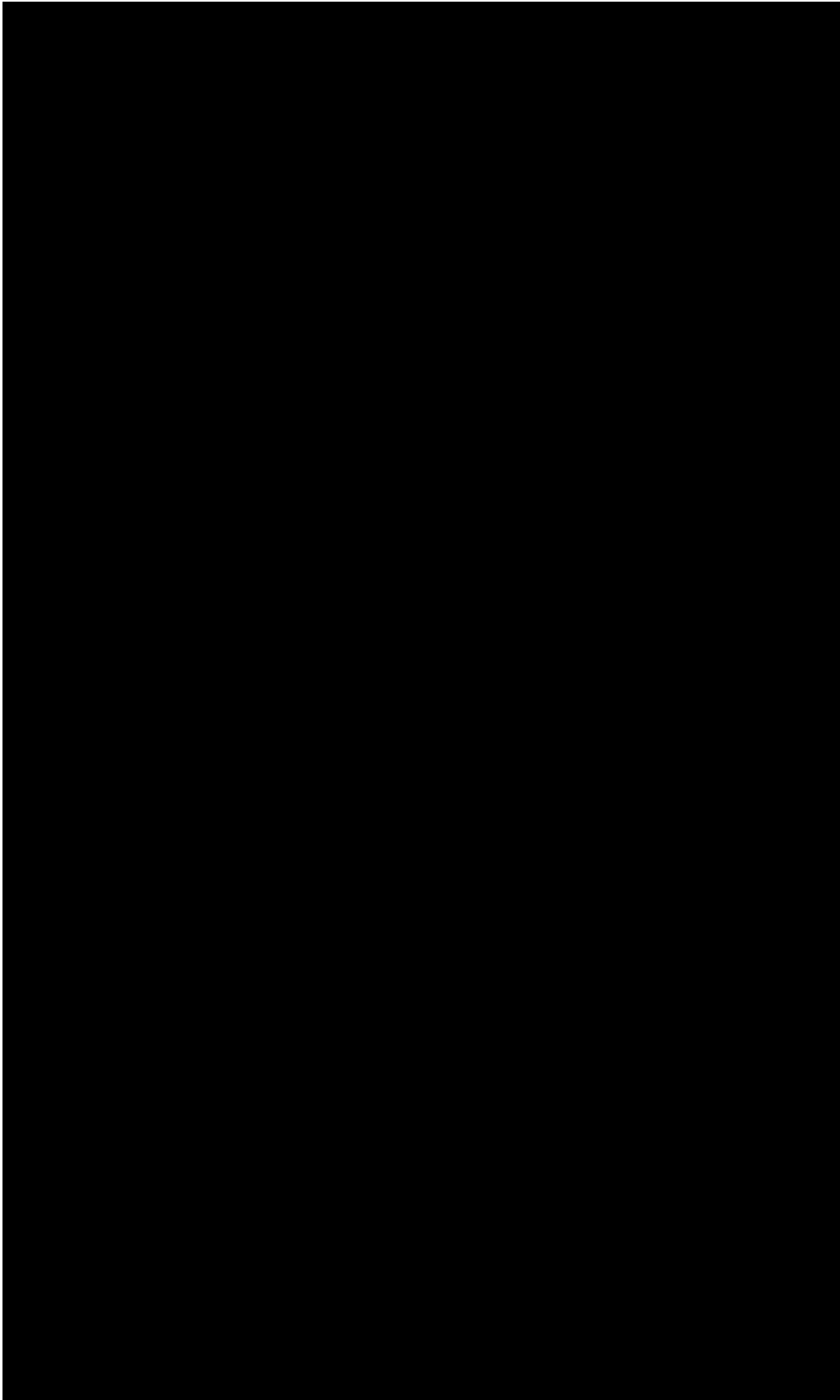


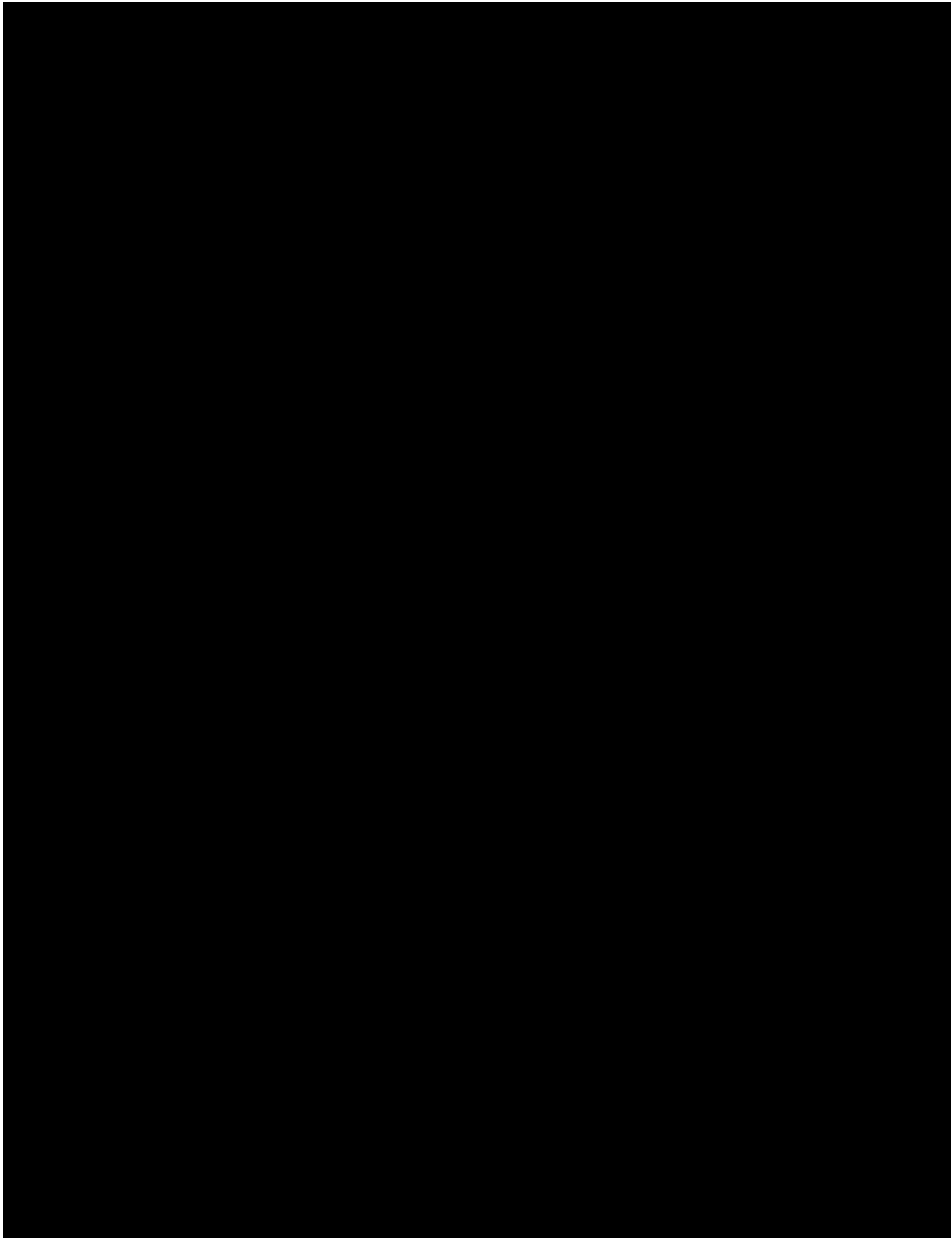












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<sup>1</sup> In this case the optimal portfolio share of the risky asset is characterized by  $\alpha^*$  that solves  $U'(\alpha^*) = 0$ ; otherwise  $\alpha^* = 0$ . To derive an analytical expression for  $\alpha^*$  one needs to assume the specific functional form of the utility function as well the distribution that governs the risky asset's return. That is beyond the scope of this paper.

<sup>2</sup> From a consumption-based asset pricing perspective, assets that decrease risk have higher prices, and therefore lower returns, as they facilitate consumption smoothing.

<sup>3</sup> See Strong (1992) for a summary of models for estimating asset returns.

<sup>4</sup> See Levis (2002) for a comprehensive review of the literature of small caps

<sup>5</sup> Herein, "investability" refers to shares that are readily available for trading in the market.

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<sup>6</sup> For the S&P 600,

[http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices\\_600/2.3.2.2.0.0.0.0.0.0.0.0.0.0.0.0.html](http://www2.standardandpoors.com/portal/site/sp/en/us/page.topic/indices_600/2.3.2.2.0.0.0.0.0.0.0.0.0.0.0.0.html) and [http://www.russell.com/Indexes/characteristics\\_fact\\_sheets/US/Russell\\_2000\\_Index.asp](http://www.russell.com/Indexes/characteristics_fact_sheets/US/Russell_2000_Index.asp) for the Russell 2000

<sup>7</sup> Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland and the United Kingdom as per <http://www.msci.com/equity/indexdesc.html#WORLD>

<sup>8</sup> [http://www.msibarra.com/resources/pdfs/methodology\\_1998.pdf](http://www.msibarra.com/resources/pdfs/methodology_1998.pdf) p. 27

<sup>9</sup> In Appendix B we also present the estimates for sub-samples that drop one year at a time, beginning with the period 2000-2007, followed by 2001-2007, and so forth. The purpose of this appendix is to demonstrate whether our results remain robust as data frequency is changed to weekly and monthly. Monthly data also allow us to examine our indexes over a larger horizon since they began to be collected as early as 1994 for the micro-cap benchmarks.

<sup>10</sup> The results of these tests are not presented here for brevity but we found no statistically significant differences with higher frequency data. Findings from monthly data will be provided upon request.

<sup>11</sup> These coefficients are calculated using the standard correlation formula. Note that the diagonal entries are all 1.0 because they represent the correlations of each index's returns with itself. Also, since the correlation between two assets A and B is the same as the correlation between B and A, a correlation matrix is symmetric about the diagonal. Therefore, it is customary to present only the lower triangle of the correlation matrix as shown in Table II.

<sup>12</sup> These correlations range from a low of 0.59 (DWMI and S&P 500, for the monthly data) to 0.72 (DJSM and S&P 500 for the weekly data) with the latter coefficient being identical to that of their daily returns.

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<sup>13</sup> For instance, Yang et al. (2006) found that the correlations among national stock markets have been steadily increasing between 1988 and 2002 and concluded that the effect of globalization may be outweighing country-specific factors in determining the co-movements of the markets.

<sup>14</sup> The dominance of these three indices in terms of their diversification benefits persists even when weekly and monthly data frequencies are used. These correlation coefficients, however, are noticeably larger than those associated with daily returns indicating perhaps that market returns on high frequency data are comparably more exacerbated by news and extra factors driving the prices of international stocks.

<sup>15</sup> The estimate for beta of index  $i$  with respect to the market index is given by  $\text{cov}(i, \text{mkt})/\text{var}(\text{mkt})$ .

<sup>16</sup> These results don't significantly change when the frequency of the data is changed to weekly and monthly.

<sup>17</sup> The first researchers to suggest this modification to alpha for ranking purposes are Smith and Tito (1969).