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What's Wrong with this Picture?
A Problem with Comparative Return Plots on Internet Finance Portals

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ARTICLES

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What's Wrong with this Picture?

A Problem with Comparative Return Plots on Internet Finance Portals¹

Investors are concerned with total return. This is a basic tenet of finance. They may differ in their preferences for current income (dividends, interest) versus price appreciation (capital gains), but total return is what eventually matters. No investor ignores a portion of his or her return. So when we analyze the performance of stocks, bonds, exchange traded funds (ETFs), or any security over time, surely it is total return that we wish to examine. But unfortunately, it is not what we see when we utilize the most visible and trusted web sources that provide information to over 41 million retail as well as institutional investors per month.²

This paper brings to light and discusses a systemic issue in the calculation and display of relative return information as seen on some of the most prominent finance sites on the web: income generating events such as dividends and interest are not included in return calculations and comparative return graphics, thus resulting in the formation of a possible availability heuristic (Shefrin, 2005). We call it the ‘Compare To’ problem.

Another problem with the issue we have uncovered is that despite the structural simplicity and obvious implication of the error, it has gone unnoticed for many years and by many people; yet its effects can be subliminal and far-reaching. A systemic and algorithmically embedded issue with the feature can, apart from creating confusion and bias, also lead to incorrect asset rankings and a mis-allocation of funds. As Elton, Gruber, and Blake (2001) point out, “All data sets have errors. The types of errors that are most harmful are systematic errors that cause biases.” The downward bias introduced in the returns due to the exclusion of income

¹ The paper has benefited from the comments and observations of the graduate finance students (Fall 2008) in our Business School.

² About 41 million unique visitors per month for all of these websites: Google Finance, Yahoo! Finance, Bloomberg.com, Microsoft's MSN Money and BigCharts.com (Nielsen/NetRatings, 2007).

events makes income generating assets seem relatively unattractive, especially when compared to assets that derive most of their growth from capital appreciation only. This can have the undesirable effect of altering the final asset mix weightings in a portfolio, even if valid investment principles are present and adhered to. The paper demonstrates this effect by deploying the classic Markowitz (1956) mean-variance optimization process.

This issue regarding the effect of non-inclusion of income generating events, in the return calculations and relative return graphics, exists on all the major finance portals that the authors have investigated--Google Finance, Yahoo! Finance, Bloomberg.com, Microsoft's MSN Money and BigCharts.com. Most of these sites are now virtually household names. BigCharts is a primary supplier of market analytics to a very extensive list of asset management firms (see Appendix A) and thus has an institutional audience; it is also a part of the Wall Street Journal's Digital Network. Bloomberg is very often a part of the essential toolkit of analytic software for most U.S. based asset managers.

Following a brief example, we will discuss the importance of looking at total returns, introduce the major online finance sites, and illustrate the effects of income exclusion on annualized returns for a set of securities, both with and without income generating events. Thereafter, we will examine the effect of this pricing differential on the calculation of the asset correlation matrices, and demonstrate the effect this can have on the asset-weight vectors that are used to generate constrained and unconstrained Markowitz style minimum-variance portfolios. The visual discrepancies are then supported by the application of the Gibbons, Ross and Shanken (1989) W-test for portfolio efficiency.

A brief example

We illustrate the ‘Compare To’ problem with an example and a chart. Chart 1 shows the five-year performance of three assets from August 2003 to August 2008, as seen on the Bloomberg website. SPY is the S&P 500 index ETF and is the line at the top. The other two assets, muddling along below SPY, are the diversified currency fund ICPHX and the long term Treasury index fund VBLTX. SPY is a more volatile asset and appears to be the more obvious and historically successful choice. From the graph, it appears that SPY has a 30% return over this period, while ICPHX has a small positive return and VBLTX has a small net loss. Unquestionably, based on this chart generated by Bloomberg, investors would have preferred to hold the S&P 500 over this period; in fact its recent weakness (as seen on the chart) could be seen as an opportunity to increase portfolio exposure towards it. The problem however is that the returns and return differentials as implied in Chart 1 are not correct, and would have consequently led to sub-optimal portfolio allocations and asset selections.

Chart 2 shows the same three securities over the exact same period, but in this case the chart was generated by the authors. The return series is based on adjusted prices that include all income-generating events (e.g., dividends, interest).³ This chart indicates that the currency fund ICPHX outperformed the S&P 500, returning 41% over the period. The Treasury bond fund VBLTX actually generated 30% over the period--quite contrary to the Bloomberg chart, which seemed to imply a negative return (all assets have a starting point of 1). Notice that the return on the S&P500 is higher by about 9% in our corrected chart, which can be attributed to the inclusion of the dividend yield on the S&P 500 return (approximately 1.4% per annum). In this example, the Bloomberg chart did not account for income events; our correction did. This omission causes

³ Numerical data was obtained from the Yahoo! Finance website (secondary provider) which provides price history along with splits and dividend information, as well as ‘Adjusted Close’ prices that incorporate corporate action and income events, for stocks, ETFs and mutual funds. The primary source of the pricing data is Commodity Systems, Inc. (CSI), the suppliers to Google Finance, Yahoo! Finance and MSN Money. Historical pricing data for BigCharts.com is provided by Interactive Data Corp, a publicly traded company.

a serious misrepresentation of asset performance and relative performance orderings, where well-performing assets could be dismissed due to perceived underperformance. Later in the paper, we will show that in a mean-variance optimization framework, the implication of such an inversion in the ranking of relative returns can be severe and lead to misallocation of funds as a result of an incomplete and biased information set available to the investor.

As our example demonstrates, ignoring dividends, interest, and coupons is a significant omission, leading to potentially significant errors in performance assessment and allocation decisions.⁴ Because dividend-paying firms are much larger and profitable than non-dividend paying firms (Grullon and Michaely, 2002), a bias against dividends is also a bias against larger firms. It is also a major bias against the entire asset class of fixed income securities.

Do dividends and interest matter?

Of course they do, and sometimes more than other times. Dividends play a signaling role (e.g., Bhattacharya (1979), John and Williams (1985), and Miller and Rock (1985)), reduce agency costs (Jensen, 1986), and have tax implications. There is evidence that investors prefer dividends more in down markets, apparently desiring the more certain “bird-in-the-hand” of dividends at such times (Fuller and Goldstein, 2005).

But what really matters is that dividends deliver a portion, often a large portion, of an investor’s return. Recall the basic formula for return (R) given price (P) and dividend (D):

$$R_{i,t} = (P_{i,t} - P_{i,t-1} + D_{i,t}) / P_{i,t-1}$$

Noer (2002) reminds us of a fascinating statistic: “one dollar invested in the S&P 500 in 1926 would be worth around \$2,260 now, including reinvested dividends. But take away the

⁴ Although not common, there are occasional studies on data reliability. For example, Elton, Gruber, and Blake (2001) examine the bias resulting from omitted mutual fund data in the CRSP database. Ince and Porter (2004) examine equity return data from Thomson Datastream (TDS).

dividends and that same dollar would have grown to just \$90. Much the same holds true today. Over the last 20 years, dividends have accounted for nearly 50% of the total return of the S&P 500.” Fuller and Goldstein (2005) found that, from 1970 to 2000, dividend-paying stocks outperformed non-dividend paying stocks, the ones we often think of as high growth stocks. The case for fixed income securities is even simpler; not including the interest payments associated with the security will severely reduce the total return (See Table 2). Thus we ignore total return at our peril. The exclusion of dividends and interest, in the return generating mechanism leads to a downward bias, and the use of such returns to rank securities would be essentially meaningless from a total return perspective.

The Finance Web Sites

Individual investors are increasingly turning to the web to obtain information on the financial markets. In addition, academics and other researchers are increasingly using online resources, as methods are developed to retrieve financial data (e.g., Hasbrouck, 2003, Corrado and Miller, 2006, Mohamed and Al-Jaroodi, 2007). Google Finance, Yahoo! Finance, Bloomberg, MSN Money and BigCharts are among the top finance websites. All finance portals provide a reasonably rich and sophisticated set of graphing tools to the visitor at virtually no direct cost. They have multiple options where entering a ticker brings up a graphical display of historical performance and optional technical indicators. They also provide earnings estimates, fundamental and even quantitative style data, apart from live news and fee-based research reports. In a way they have done an outstanding job reducing the informational asymmetries between the investor on Wall Street and the one from Main Street.

These sites have enormous reach. Consider BigCharts. This is one of the most comprehensive and developed sites that delivers financial analytics over the web. It is owned by Dow Jones & Company and operates under the Wall Street Journal Digital Network. BigCharts also licenses and provides its output to visible industry members such as MerrillLynch.com, Morgan Stanley, UBS, Citibank, Fidelity.com, WSJ.com, Financial Times, New York Times, Barron's, as well as brokers such as Ameritrade.com, Schwab.com and Marketwatch.com; their clients form a financial who's who list (see Appendix A). BigCharts also licenses its technology and builds customized client solutions. The Wall Street Journal Digital Network claims to service at least 39 million unique visitors per month with over 616 million monthly page views [<http://dowjonesonline.com>]. An earlier report by Nielsen/NetRatings released in September 2007 indicates that the above mentioned sites had an aggregate of about 41 million unique visitors for the month of August 2007 (see Appendix B for individual site statistics). The visibility and reporting burdens that come attached with access to such a massive audience are immense.

Security Selection and Study Period

A synopsis of the problem was provided in our earlier example. In this section, we illustrate systematically what is occurring when one uses these websites. We select a set of eight highly liquid securities; together these securities cover all major asset classes, comprise a highly diversified portfolio, and were chosen to have minimal overlap. In addition these securities are tradeable and have continuous pricing history available since December 31, 1999. This was chosen as the starting point since Google begins all its mutual fund charts only at this point. (Yahoo and BigCharts have the ability to go back earlier, while Bloomberg can only go back five

years.) Additionally, this period includes at least one full bear market and one full bull market, thus insulating the study from any form of market-phase bias. The securities are a mixture of common stocks, mutual funds and an ETF (Exchange Traded Fund). This also eliminates any specific security-class bias. We will show that the problem applies to any type of traded security. The eight securities are listed in Table 1.

There are two stocks in the study, one of them pays a steady stream of dividends (PFE, Pfizer) while the other has had no dividends since its inception in 1990 (GENZ, Genzyme). Both are bellwether stocks and have the highest market capitalization in their respective industries (Pharmaceuticals, Biotechnology). Our ETF is the S&P 500 index tracking ETF (SPY), which is the most actively traded security on the U.S. exchanges with an average daily trading volume (3 month moving average) of about 260 million shares; by comparison the trading volume of Pfizer, Genzyme, General Electric and Exxon Mobil are 50 million, 3 million, 63 million and 29 million shares respectively.

In addition to the S&P 500 ETF, five mutual funds were chosen to create a diversified multi-asset class portfolio. Between the SPY and the VGTSX, the largest and most liquid common stocks in the U.S., Europe, Australasian and Emerging markets are represented. The Treasury bond, gold, hard currency and real-estate classes are proxied by VBLTX, FSAGX, ICPHX and VGSIX funds respectively.⁵

This set of highly liquid assets is chosen to minimize redundancies, illustrate the effects of income exclusion from price series, and yet have a relatively complete coverage of tradeable proxies for the broad asset classes (for mean-variance optimization purposes as shown later in the paper).

⁵ These selections are tradeable diversified funds that also proxy the broader asset classes, and can be the constituents of a typical portfolio for a visitor to these sites. They are also highly capitalized and have market history going beyond 1999.

Generating a Comparison Graph

In the “Compare To” or “% Compare” or “Compare” feature, one or more securities can be compared to a base security. All of the online finance sites offer this feature in their charting section. It is a commonly used option for investors who wish to see how their investments are performing relative to a baseline security. Unlike the basic chart, which normally shows a security’s price over time, the “compare” chart displays percentage changes, on the Y-axis, over the time period selected.

Appendix C is a direct cutout from the BigCharts website, which explains what the % Compare feature does. Note that the BigCharts explanation claims that the chart shows “relative performance” and that the feature indicates if one company is “outperforming” or “underperforming” the stock of another. Outputs from Yahoo! Finance, Google Finance, Microsoft’s MSN Money and Bloomberg are in similar percentage return format and will be discussed shortly. Google even provides a percentage return number over the range of the period for which the chart is drawn. (See Appendix D for instructions for generating the compare graph for a selection of sites.)

Chart 3 is what a user sees if they choose BigCharts then click on “advanced chart”, enter SPY followed by VBLTX, and choose ‘% change’ on the lower indicator. A curious user may spend a few minutes to discern what ‘% Compare’ is telling them (the lower chart). It appears that since the year 2000 (12/31/1999 to be precise, which is entered in the Custom ‘time frame’ box), the VBLTX (Vanguard long term Treasury index) has out-performed the S&P 500 by about +25%. Moreover it appears that VBLTX has generated a return of about 14% over the 8 ½ year period (upper chart), which is about 1.6% per year. This second piece of information could

raise a question in the mind of a user who is conversant with historical attributes of various asset classes. The Ibbotson Report (SBBI, 2006) lists the average annual return on U.S. long term Treasury bonds to be about 5.9%. Clearly something is missing, but there is little to indicate the omission and the cause for the discrepancy in the annual bond returns.

As we have suggested, this issue is not limited to the Bloomberg or the BigCharts websites. An examination of three other major finance portals reveals the persistence of this omission. The information is the same at MSN Money (Chart 4). To conserve space we have included PFE as well, as a comparison with the SPY, along with VBLTX in the same graph. It may be a little harder to estimate the numerical numbers associated with the graphical output but the VBLTX line is relatively flat at about 14%, SPY around -14%, and PFE at a -40% return over the exact same period as the output from BigCharts above. Note that while Pfizer did not do well in this period, its return when including income events (dividends) was not quite so bad as it appears (-3.3% per annum in reality versus the -5.5% per annum illustrated in Chart 4, see next section).

To complete the comparison, we also produced graphs of SPY, VBLTX and PFE from the Yahoo! Finance website (Chart 5) and the Google Finance site (Chart 6). In both cases, the information and its presentation are very similar. The 'Compare' graph from Google does have one advantage over the other sites; it provides specific numerical values of the percent returns associated with each security in the graph. For SPY, VBLTX and PFE the numbers are -13.28%, +14.55%, and -43.71% respectively. Thus the user does not have to guesstimate the numerical values from the location of the lines on the graphical output. There is however no indication to the viewer that such comparative return information does not include any income event whatsoever, and thus produces a downward bias in the cumulative return numbers or the

graphical ordering of the securities being researched. Note that none of the sites include an option for including income events in the return comparison.

Annualized Returns with and without Income

The annualized returns associated with each of the selected assets over the same time period (12-31-99 to 8-7-2008, as used in the graphs above) are presented in Table 2. The non-inclusion of dividends or interest leads to a different set of annualized returns. The effect is more pronounced for Bonds, Gold Stocks, Currency, REITs--assets that traditionally generate higher income streams. The gold fund is underestimated by 7.1%, long term government bonds by 5.9%, REITs by 5.7%, and currency by 5.3%; recall these are annualized or per year errors. The compounded effect over time is extraordinary, to say the least. The exclusion of such large annual returns from a comparative return analysis portrays a different image of the asset, from what truly is the case. The total return differential can be thought of as an annual return loss that is not available to the viewer and thus not part of their information set. The stock GENZ has a zero return differential because it is a non-dividend paying stock. This security also illustrates the only scenario when the return comparison charts, in their current form, would be accurate. A sub-optimal portfolio allocation decision can manifest as a result of the 'availability heuristic' that the user would be automatically subject to--that is, agents tend to overweight information that is readily available and intuitive, relative to information that is less salient and more abstract, thus biasing judgments (Shefrin, 2005). The omission of such key information in what is made available to users of these websites, has the potential to affect their portfolio selections adversely.

Correlations

Except for BigCharts, the other three sites allow the user to download price data for a particular security and a specified date range. Google's price history does not even include any dividend payouts, while MSN Money and Yahoo! Finance provide that information in the download. In fact, Yahoo! Finance provides an additional column of pricing data called the 'adjusted close' that incorporates dividends, splits, stock dividends and similar corporate actions. The free availability of such pricing data on the web has drawn users to download such information and compute their own devices for portfolio analytics. This section illustrates the effect of using pricing data that excludes dividends (such as provided by Google Finance) or failing to adjust for it (as provided by MSN Money) or using the raw Close price instead of the Adjusted Close price (as provided by Yahoo! Finance).

In addition to resulting in a total return differential, ignoring income events also affects asset correlations. The correlations among the chosen assets are presented in Table 3. The equation for the correlation coefficient is given by:

$$Correlation(x,y) = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

where \bar{x} and \bar{y} are the sample means of x and y respectively.

The estimation of the covariance between two assets is eventually affected, since $\mathbf{cov}(x,y) = \sigma_x \sigma_y \rho_{xy}$, where σ is standard deviation and ρ is the correlation, which ultimately affects the level of systematic risk (β) and portfolio allocations (asset weights).

Changes to the correlations (when we add income events to the returns) are modest but not without importance. The ones that change the most are those for Bonds and Currency (see the columns for VBLTX and ICPHX). It is expected that if these two assets are included in a

portfolio then the optimal weights for the assets will vary and be dependent on which of the two correlation matrices is utilized for the mean-variance optimization.⁶

Optimal Asset Allocation Errors

What if an investor was making decisions based on the comparison charts? We will assume the investor is creating efficient portfolios utilizing the Markowitz minimum variance optimization process. The mean-variance efficient portfolio selection problem is one where the investor seeks to minimize the portfolio variance subject to the budget and target return constraint. A short selling non-negativity constraint is optional, depending on the model. In this exercise the non-negativity constraint is enforced⁷. Simply stated, the problem is to:

$$\begin{aligned}
 &\text{Minimize } \sigma^2(\mathbf{x}) = \mathbf{x}^T \Sigma \mathbf{x} \\
 &\text{subject to,} \\
 &\mathbf{x}^T \mathbf{e} = 1 \text{ where } \mathbf{e}^T = [1, 1, \dots, 1] \\
 &\mathbf{x}^T \boldsymbol{\mu} = \mu_p \\
 &\text{and } \mathbf{x} \geq \mathbf{0} \text{ (optional)}
 \end{aligned} \tag{1}$$

where,

$\boldsymbol{\mu}$ and \mathbf{x} are n-vectors composed of asset rates of return and portfolio weights respectively,

Σ is an n x n positive-definite non-singular covariance matrix (the positive definiteness of Σ ensures that the value of the quadratic norm $\sigma^2(\mathbf{x})$ will be positive for all $\mathbf{x} > \mathbf{0}$, essentially ensuring a positive variance (Greene, 1993),

\mathbf{e} is a unit vector,

and μ_p is a scalar equal to the targeted portfolio return.

⁶ In the market decline since October 2007 there have been numerous instances where market *pundits* have been lamenting the limited exposure to these two asset classes in client portfolios.

⁷ This can be relaxed without loss of generality, but since mutual funds in the portfolio typically do not allow for short-selling, we apply the constraint.

Excluding the two stocks in our asset set, we have representation of all the primary asset classes--US Equities (SPY), International Equities (VGTSX), US Treasuries (VBLTX), Gold (FSAGX), Real Estate (VGSIX) and Hard Currency (ICPHX). An Ibbotson-NAREIT (2006) report shows the improvement in the risk-return tradeoff by including REITs in an optimal asset-allocation process. VGSIX is the index for REITs and our proxy for real estate. Tables 4 and 5 contain the results of the optimization on these assets using returns over the period 12/31/1999 to 8/7/2008. To determine the differential impact of using return series that did not include income events, two entirely separate data sets were created. Each of them has its own correlation structure, as shown previously. An efficient frontier was created using each set of returns (see Chart 7). The optimization was run to determine two separate points on the efficient frontier. Table 4 lists the optimal weights associated with the minimum variance portfolio on the efficient frontier. The minimum variance portfolio would be the left-most point on the curves in Chart 7. Table 5 displays information pertaining to the points on the frontier that have the maximum feasible return/risk ratio. These are the points of tangency identified by the large dots on the two efficient frontiers as shown in Chart 7.

If we create a portfolio using (inaccurate) data that does not include income events, and compare it to a portfolio that uses (accurate) data that does include income events, then the portfolio that includes the extra income events will be superior, at all risk levels. That is what we see in panel A, Table 4. The standard deviation is lower by about 0.08% for the portfolio that includes income events, while the return is higher by 4.5%, in absolute terms. Notice that the portfolio weights are almost identical in the two cases. The 4.5% loss can be attributed to a composite of the yield on these assets that is not included in the price-return calculations. That is also the information loss to the user who views the relative return plots on each of the websites.

But panel A, Table 4, shows inaccurate returns. This is because whether or not the chart shows the income events, the holder of the security will receive the income stream. Panel B, Table 4, makes a more interesting comparison. In this panel we compare actual returns (that is, with income events) of a portfolio selected based on the optimization of the wrong returns, and compare it to a portfolio selected based on the optimization of the correct returns. For the minimum-variance case the effects are very minor, although it does decrease the allocation to SPY and increase VGSIX (real estate). The return to risk ratio is slightly improved if the correct data is used. We repeated the exercise, but now we created portfolios to maximize the return/risk ratio (μ/σ). This is where considerable migration of weights and change in portfolio returns is observed. See Table 5. The (μ, σ) parameters of the optimal portfolios are higher than what was attained in the minimum variance case. In Panel A, Table 5 one can see that the return of the income generating portfolio is over 40% above that of the income excluding portfolio (9.37% versus 6.61%). This difference in returns is not due to better security performance; it is simply due to the exclusion of income events in the ‘under-performing’ portfolio and the resulting shifts in the portfolio weights. The return/risk ratio jumps over 90% from 0.65 to 1.24, for the portfolio whose weights are determined using the correct set of returns. Once again, Panel B is the interesting panel. Notice that the portfolio calculated using the wrong (no income event) data has a lower return/risk ratio. The portfolio weights have changed rather significantly, with a sharp reduction to FSAGX (gold) and an increase to ICPHX (currency). The allocation to VGSIX (real estate) has also declined. The risk associated with the sub-optimal portfolio is about 10%, which is about 33% higher on a relative basis compared to the optimal portfolio that has a risk of about 7.5%. Clearly, the distortion of returns created by omitting income events can have real portfolio allocation and performance effects. Additionally, the impact of this omission

leads to a reduced capital allocation towards asset classes that derive a significant portion of their total return from income events. In the simulation shown above these asset classes are gold, currency, and real-estate.

Recall that the large (red/solid) dot in Chart 7 is the location of the maximum return/risk (tangency) portfolio for each case (Panel A of Table 5, (μ, σ) values). It can be safely said that the ‘with income’ based frontier dominates the other – at each level of risk, the income including frontier has a superior level of return compared to the no income frontier. But also notice the point indicated with the (green/solid) triangle (10.05, 11.58). This is the maximum return/risk portfolio from Table 5, Panel B, the portfolio whose weights were calculated using the wrong data (no income events included), but whose performance is based on actual returns. The point to be made is that using the wrong data, as provided on these finance portals, leads to a portfolio with a lower return/risk ratio. The visual determination (Chart 7) is confirmed by applying the exact Gibbons, Ross and Shanken (1989) W-statistic, given as:

$$W = \left[\frac{\sqrt{1 + \hat{\theta}_*^2}}{\sqrt{1 + \hat{\theta}_p^2}} \right]^2 - 1 \equiv \Psi^2 - 1$$

With a p-value of 6.27×10^{-49} , the null hypothesis of portfolio efficiency is easily rejected (see Appendix E for details). All points on the line connecting the risk-free return (1.72% on the Y axis) and the portfolio shown by the triangular point (the optimal range of possible portfolios that mix the risk-free asset and the risky portfolio) lie below the possible combinations of the risk-free asset and the portfolio calculated using accurate income inclusive returns (point 7.54, 9.37).

With the way the comparative returns of two securities are displayed on some of the leading finance portals, the users are most likely unknowingly operating off the efficient frontier

which lies within the attainable higher frontier. That will likely lead to a sub-optimal allocation of capital toward income generating asset classes.

Conclusion

This paper has demonstrated and brought to fore a long-standing and widespread distortion in the depiction of relative return performance of financial securities on all of the major finance web portals; somehow this has evaded the scrutiny of millions of visitor investors. As shown earlier, the omission by the portals results in significant calculation, ranking, and portfolio allocation errors; the distortion will occur with all income generating securities. This error is served up to a very large captive audience and it is possible that their assessment of desirable securities is altered by this misinformation.

To reinforce the message, in Chart 8 we replicate the distortion found on the websites using our template. These charts replicate/reverse-engineer the “compare” feature in which SPY (S&P 500 ETF) is the baseline, pegged to one (Y axis) at the beginning of the period. Thus the performance of VBLTX (bonds) is relative to the S&P 500. The two graph panels show the same securities but they differ in the treatment of the income generating events for the calculation of the returns and the price paths. In the first one it appears VBLTX (bonds) have outperformed the S&P 500 by 28% over a nine year period. This is the same view an internet user would find on Bloomberg, Yahoo! Finance, BigCharts, MSN Money or Google. In the bottom graph (of Chart 8) we find that the actual out-performance was significantly higher, at 89%. The comparative plots as seen on the internet understate the true performance of income generating assets.

The result of these distortions is that assets that have a higher income generating component in their total returns would appear to be less desirable holdings in a portfolio allocation scheme if such comparative graphing is utilized. Such security types include fixed income debt securities and dividend paying equity securities (at the stock, mutual fund, index, or ETF level). If retail investors or financial advisors use the ‘compare to’ option to estimate the relative attractiveness of two securities, it is possible that they would surmise that the high income generating security is unattractive and as a result be under allocated to them. The financial crisis of 2008 has led many investors to look into and review their portfolio holdings and allocations, and anecdotal evidence indicates that a large majority was underexposed to assets that generated income or dividends. It would be a stretch to conclude that the “compare to” feature created this result. But it is possible that such graphing features subliminally and continually reinforced a perception, in the mind of some investors, that income securities were perpetual under performers, when in fact they were delivering steady returns (as shown in Table 2).

It does not have to be so. Most of the sites have dividends or interest income available in their historical price downloads (Google however offers only price information, without consideration for dividends). All that these sites have to do is include the income information while generating ‘comparison’ graphs, by making a few alterations to their graph generating algorithms. That would give a more complete and accurate picture of the relative return differentials over time for the securities being compared, and make available a better information set to the user. If for some reason it is not possible for the providers to alter their comparative return generating algorithms, then the user has the right to see a disclaimer next to the chart: “These return comparison graphs do not include income events, which may result in a downward

bias in the displayed end-period returns. The implication of this for ranking securities and allocation of funds should be considered carefully by the user, before basing any decisions on the displayed chart.”

Ultimately these brand-name finance portals have a responsibility to their visitors and should consider corrective action. The ready availability of such unclear or inaccurate information from sources generally perceived to be very credible can in this age of ‘do it yourself’ portfolio management have serious and damaging financial consequences to the unsuspecting investor.

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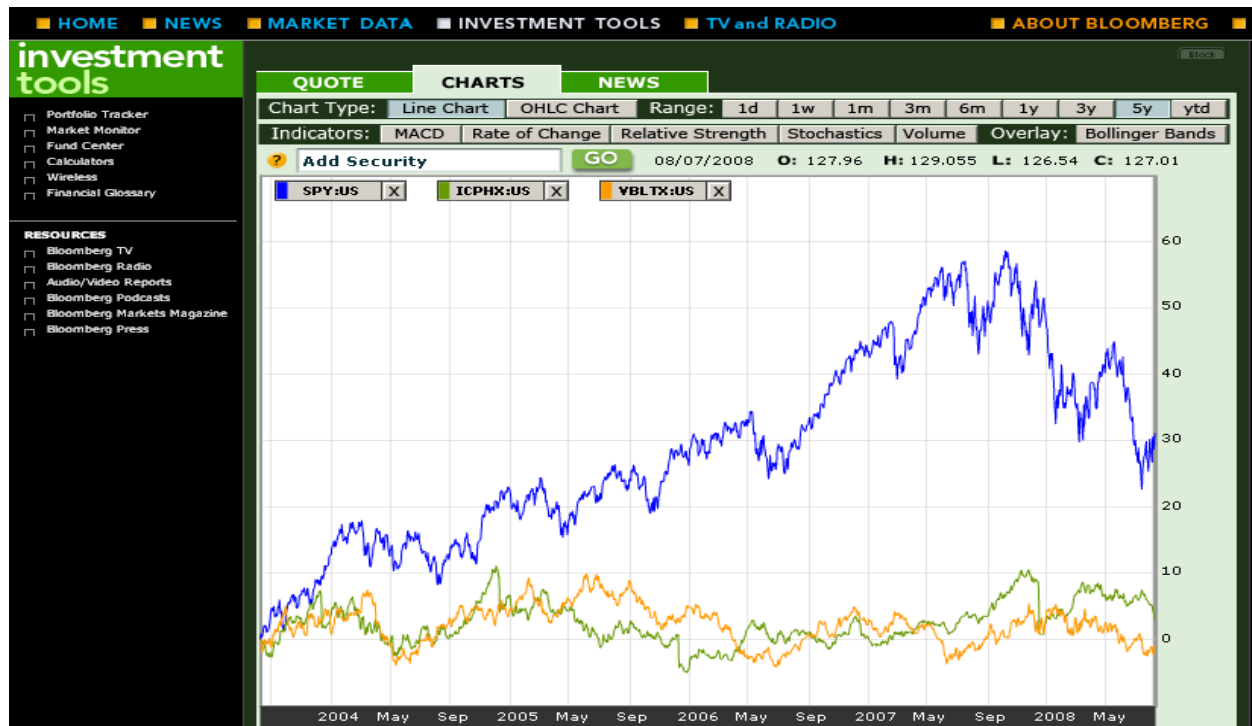
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Chart 1: Performance of Three Assets from Bloomberg



Source: Bloomberg.com. Chart generated 08-17-2008.

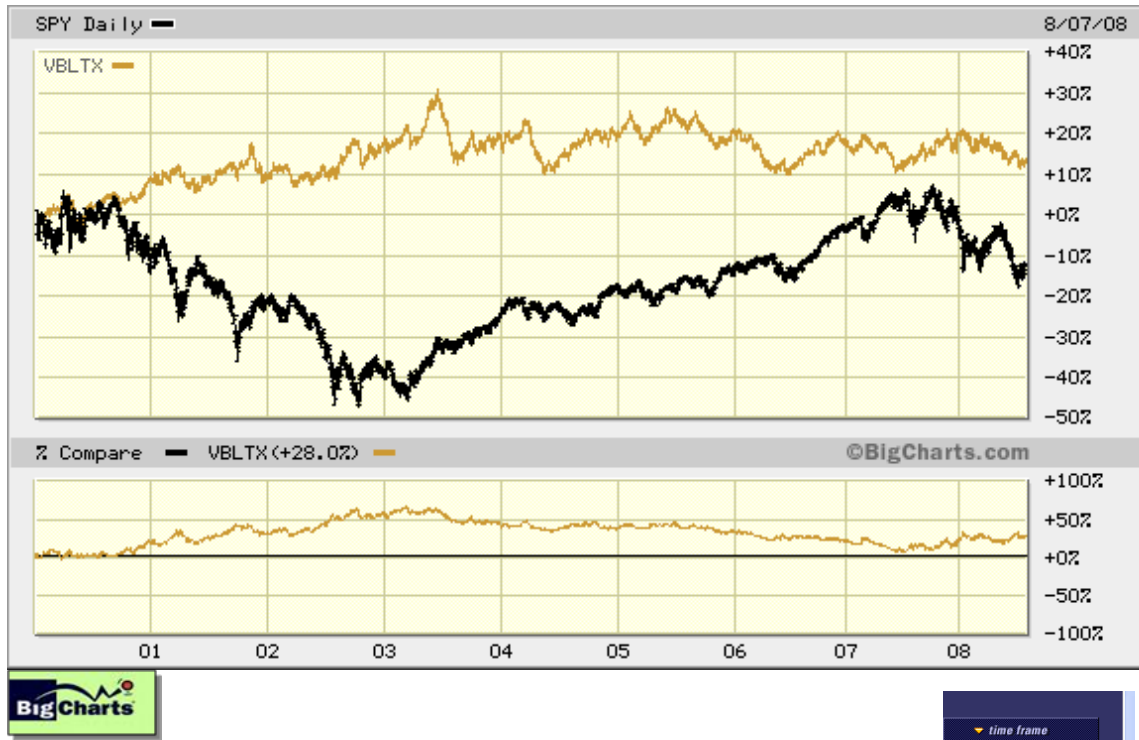
Return comparison generated by Bloomberg.com for SPY (S&P 500 ETF), ICPHX (currency fund), and VBLTX (Treasury Fund), Aug-2003 to Aug-2008.

Chart 2: Performance of Three Assets from the Authors



Return comparison generated by the authors for SPY (S&P 500 ETF), ICPHX (currency fund), and VBLTX (Treasury Fund), Aug-2003 to Aug-2008. This depiction includes income events.

Chart 3: Comparing the S&P 500 tracking ETF (SPY) and the Long Term US Treasury Index (VBLTX) on BigCharts (12/1999 to 8/2008)



time frame

Time: Custom

Custom Time Frame: From: 12/31/1999 To: 8/7/2008

Frequency: Weekly

Chart 4: MSN Money Site Comparison Chart (12/1999 to 8/2008)



Chart 5: Yahoo! Finance Site Comparison Chart (12/1999 to 8/2008)



Chart 6: Google Finance Site Comparison Chart (12/1999 to 8/2008)



Chart 7: Mean Variance Efficient Frontiers

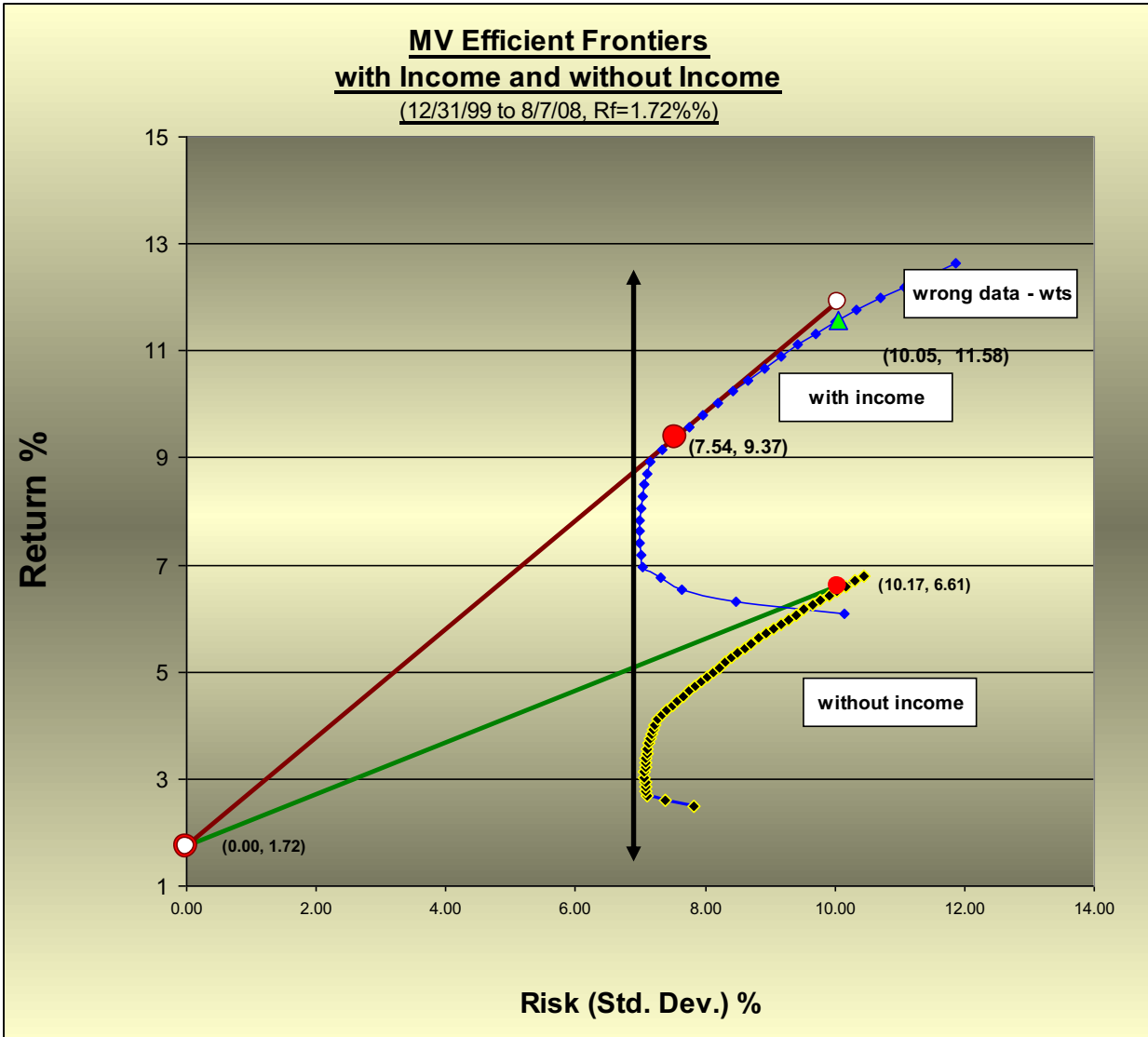
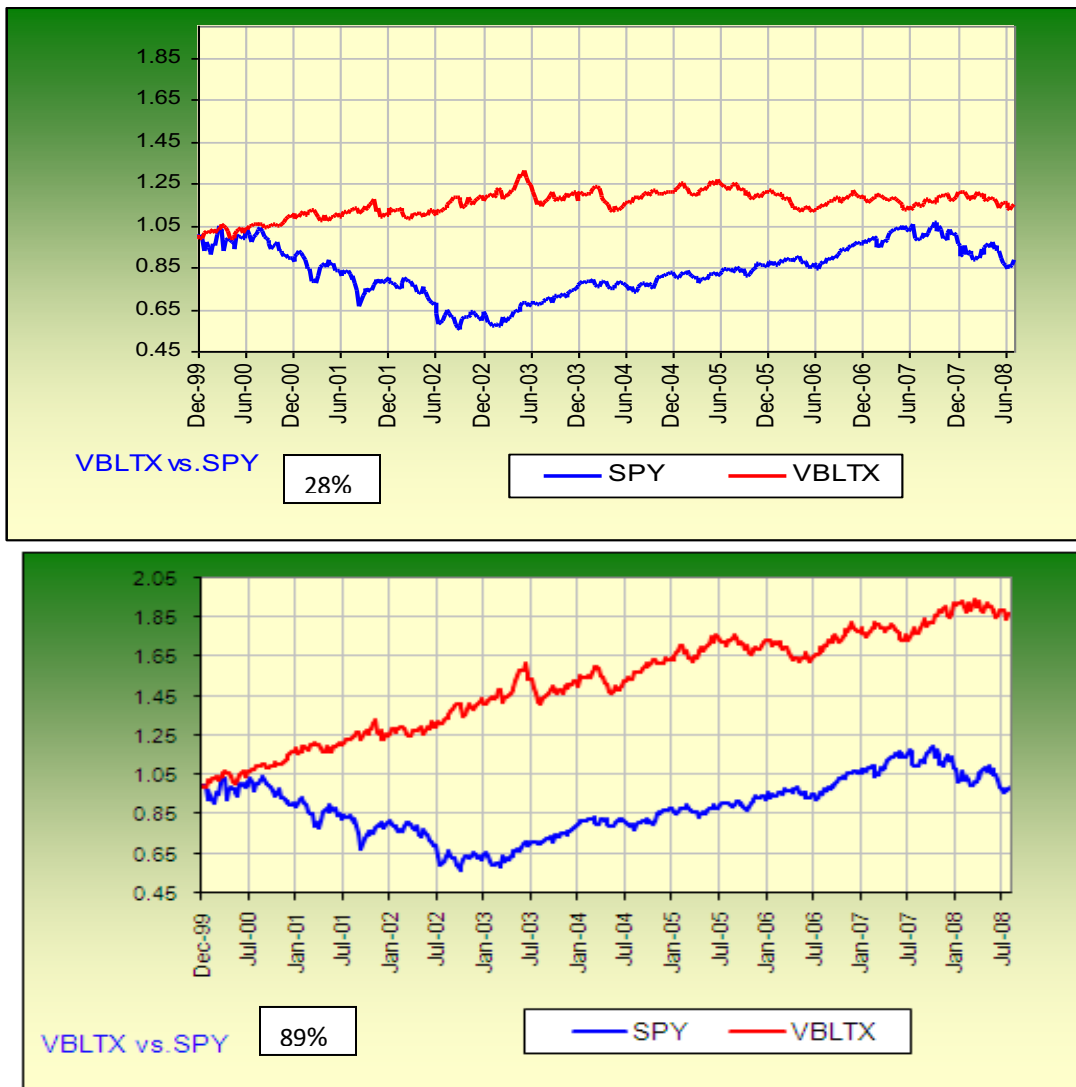


Chart 8: A Comparison of the Actual (as seen on the Internet) and Corrected Relative Performance Plots for VBLTX (bonds) and SPY (equity) ((12/1999 to 8/2008))



The two graph panels show relative performance (the “compare” feature) for the same securities (SPY, VBLTX), but they differ in the treatment of the income generating events for the calculation of the returns and the price paths. The top graph does not include income generating events while the bottom graph does. The bottom graph shows accurate relative returns.

Table 1: Sample Portfolio Assets

Asset name	Ticker	Market Cap	Inception Date
S&P500 Depository Receipts (Spiders) S&P500 Tracking ETF	SPY	65B	Jan, 1993
LT Treasury Bond Index - Vanguard	VB�TX	2.8B	Jun, 1996
Total Int'l Stock Index –Vanguard	VGTSX	27B	Jun, 1996
Fidelity Select Gold Fund	FSAGX	2.3B	Jan, 1987
Franklin Tempelton Hard Currency Fund	ICPHX	0.69B	Jun, 1995
REIT Index Fund – Vanguard	VGSIX	7.29B	Jun, 1996
Pfizer Inc.	PFE	130B	Jan, 1982
Genzyme Corp.	GENZ	20B	Mar, 1990

Table 2: Annualized Returns (12/1999 to 8/2008)

Annualized Returns (12/31/1999 to 8/7/2008)								
	S&P500	LT Bonds	Int'l Stocks	Gold	Currency	REITs	Pfizer	Genzyme
	SPY	VLTX	VGTSX	FSAGX	ICPHX	VGSIX	PFE	GENZ
Without Income Events	-1.5%	1.6%	1.9%	9.7%	0.4%	9.0%	-5.5%	15.3%
With Income Events	-0.2%	7.5%	4.0%	16.8%	5.6%	14.7%	-3.3%	15.3%
Return Differential	1.3%	5.9%	2.1%	7.1%	5.3%	5.7%	2.2%	0.0%

Table 3: Correlations (12/1999 to 8/2008)

Correlations								
	SPY	VBLTX	VGTSX	FSAGX	ICPHX	VGSIX	PFE	GENZ
SPY	1.00	-0.16	0.78	0.09	-0.05	0.52	0.46	0.38
VBLTX	-0.16	1.00	-0.13	0.08	0.16	-0.05	-0.07	-0.09
VGTSX	0.78	-0.13	1.00	0.32	0.22	0.46	0.39	0.28
FSAGX	0.09	0.08	0.32	1.00	0.44	0.12	0.01	-0.07
ICPHX	-0.05	0.16	0.22	0.44	1.00	-0.01	0.00	-0.10
VGSIX	0.52	-0.05	0.46	0.12	-0.01	1.00	0.34	0.16
PFE	0.46	-0.07	0.39	0.01	0.00	0.34	1.00	0.17
GENZ	0.38	-0.09	0.28	-0.07	-0.10	0.16	0.17	1.00

Correlations for assets
without income included

12/31/1999 to 8/7/2008

Correlations								
	SPY	VBLTX	VGTSX	FSAGX	ICPHX	VGSIX	PFE	GENZ
SPY	1.00	-0.12	0.78	0.09	-0.08	0.52	0.46	0.41
VBLTX	-0.12	1.00	-0.08	0.09	0.22	-0.02	-0.05	-0.08
VGTSX	0.78	-0.08	1.00	0.34	0.22	0.47	0.39	0.31
FSAGX	0.09	0.09	0.34	1.00	0.47	0.13	0.00	-0.07
ICPHX	-0.08	0.22	0.22	0.47	1.00	0.00	-0.01	-0.15
VGSIX	0.52	-0.02	0.47	0.13	0.00	1.00	0.34	0.17
PFE	0.46	-0.05	0.39	0.00	-0.01	0.34	1.00	0.19
GENZ	0.41	-0.08	0.31	-0.07	-0.15	0.17	0.19	1.00

Correlations for assets
with income included

12/31/1999 to 8/7/2008

Table 4: Minimum Variance Portfolios (12/1999 to 8/2008)

**Panel A: Returns
with and without
income**

	Portfolio Weights								
	Portfolio St Dev	Portfolio Return	Return/ Risk	SPY	VBLTX	VGTSX	FSAGX	ICPHX	VGSIX
With returns excluding Income	7.07	3.13	0.44	16.5	29	7	7	29	11.5
With returns including Income	6.99	7.63	1.09	16.3	29	7	7	29	11.7

**Panel B: Both
returns including
Income**

	Portfolio Weights								
	Portfolio St Dev	Portfolio Return	Return/ Risk	SPY	VBLTX	VGTSX	FSAGX	ICPHX	VGSIX
Weights calculated using wrong data	6.99	7.61	1.09	16.5	29	7	7	29	11.5
Weights calculated using right data	6.99	7.63	1.09	16.3	29	7	7	29	11.7

Table 5: Maximum Return/Risk Portfolios


Panel A

	Portfolio Weights								
	Portfolio St Dev	Portfolio Return	Return/ Risk	SPY	VBLTX	VGTSX	FSAGX	ICPHX	VGSIX
With returns excluding income	10.17	6.61	0.65	7	29	7	20.2	7.8	29
With returns including income	7.54	9.37	1.24	7	29	7	7.7	24.8	24.5

Panel B: Both returns including Income

	Portfolio Weights								
	Portfolio St Dev	Portfolio Return	Return/ Risk	SPY	VBLTX	VGTSX	FSAGX	ICPHX	VGSIX
Weights calculated using wrong data	10.05	11.58	1.15	7	29	7	20.2	7.8	29
Weights calculated using right data	7.54	9.37	1.24	7	29	7	7.7	24.8	24.5

Appendix A: BigCharts Licensing Partners

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Appendix B: Business and Financial Website Numbers

Nielsen/NetRatings has released its numbers for the major US financial websites.

Yahoo! (YHOO) Finance remains in first place with over 16.8 million unique visitors in August. Time per person spent on the site is over 23 minutes, also the highest among the top 20 financial destination. In time spent, Wall Street Digital is second at over 22 minutes.

Top Online Financial News and Information Destinations for August 2007

Brand or Channel	Unique Audience (000)	Time Per Person (hh:mm:ss)
Yahoo! Finance	16,844	0:23:35
MSN Money	12,297	0:19:13
AOL Money & Finance	10,077	0:16:58
Forbes.com	9,136	0:05:18
Wall Street Journal Digital	8,445	0:22:39
CNNMoney	8,105	0:14:00
Reuters	6,355	0:05:25
Bankrate.com	3,977	0:07:20
Bloomberg.com	3,502	0:05:26
TheStreet.com	3,491	0:07:50
Motley Fool	3,369	0:16:32
American City Business Journals Network	2,821	0:03:22
BusinessWeek Online	2,796	0:04:15
FreeCreditReport.com	2,637	0:09:49
About.com Business & Finance	2,557	0:01:57
Smartmoney	1,880	0:11:32
USATODAY.com Money	1,875	0:05:09
FT.com	1,765	0:03:04
Google Finance	1520	0:16:08
Morningstar	1466	0:19:24

Source, Nielson/NetRatings, available at <http://www.247wallst.com/2007/09/business-and-fi.html>

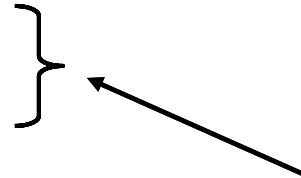
Appendix C: BigCharts %Compare Feature

% Compare

The % Compare indicator shows the relative performance of symbols that you compare to your chart's focus symbol. It creates a baseline based on your chart's focus symbol, around which all other stocks, mutual funds or indexes are compared.

For example, if you apply IBM as your focus symbol, and then in the "compare to" section add MSFT, the percent compare indicator will display IBM as a flat line in the middle of the indicator window with MSFT's performance plotted relative to IBM. If MSFT's line rises above IBM, it means that MSFT is outperforming IBM. If it declines below IBM, it means that MSFT is underperforming IBM.

Note: this indicator is useful because it returns the final percentage by which the compared symbols underperformed or outperformed the focus symbol.



Appendix D: Using the “Compare” Feature.

BigCharts

Go to BigCharts.com (actually you will go to <http://BigCharts.marketwatch.com/>). Enter a ticker symbol and choose “advanced Chart.” On left choose time period and click on “compare to” and enter a ticker of choose an index. Click “draw chart.” If you wish to see “% compare” make that choice in “lower indicator.”

MSN Money

Go to <http://moneycentral.msn.com/investor/home.aspx>. Enter a symbol and click “get quote.” Choose “charts” below the chart showing. Here choose time period and enter symbol(s) to compare to. Click “redraw chart.”

Yahoo! Finance

Go to <http://finance.yahoo.com/>. Enter symbol and click “get quote.” Beneath the small chart choose a time period. When the new chart appears, click “compare” and enter symbol or choose an index.

Google Finance

Go to <http://finance.google.com/finance>. Enter symbol and click “get quote.” The “compare” chart should be showing. Add a symbol or choose an index to compare to.

Bloomberg

Go to Bloomberg.com. Enter quote. Choose “Chart” from tab. Enter additional symbols in “add security.” Click “Go.”

Appendix E: The GRS Statistic: Geometrical Test for Portfolio Efficiency

Gibbons, Ross and Shanken (1989) devised an exact form statistic to test for the MV efficiency of a given portfolio based on its geometric properties. The test is widely used in studies addressing the issue of portfolio efficiency and CAPM deviations (Brennan, Wang, and Xia (2004), MacKinlay (1995), Roll and Ross (1994), Zhou (1993) and Fama and French (1993, 1996)).

The GRS statistic measures the distance, in mean-standard deviation space, between a test portfolio (market index) and a tangency portfolio (on the efficient frontier) and returns a value, which is then used to assess the relative efficiency of the portfolio under consideration. The GRS statistic denoted by W is given as:

$$W = \left[\frac{\sqrt{1 + \hat{\theta}_*^2}}{\sqrt{1 + \hat{\theta}_p^2}} \right]^2 - 1 \equiv \psi^2 - 1 \quad (1)$$

where, $\hat{\theta}^*$ is the Sharpe measure of the *ex post* efficient portfolio (ratio of expected excess return to the standard deviation of the excess return), and $\hat{\theta}_p$ is the Sharpe measure of the test portfolio. Essentially θ is a slope measure ($\theta \equiv \bar{r} / \sigma$) with excess return (\bar{r}) and standard deviation of return (σ), and is the ray emanating from the origin on the Y-axis connecting to a portfolio in the first quadrant. Note that ψ cannot be less than one since $\hat{\theta}^*$ is the slope of the *ex post* frontier and is based on all the assets in the test (including portfolio p). To accept the efficiency of the test portfolio, ψ^2 should be close to 1. Larger values of ψ^2 imply portfolio inefficiency arising out of the increased distance between the test portfolio and the global MV efficient portfolio on the frontier ($W = \psi^2 - 1 \rightarrow 0$ implies efficiency). In other words, for values of W close to zero, the test portfolio cannot be called inefficient.

The test statistic is determined as:

$$[T(T-N-1) / N(T-2)] * \left[\frac{\sqrt{1 + \hat{\theta}_*^2}}{\sqrt{1 + \hat{\theta}_p^2}} \right]^2 \equiv X_F$$

It follows a F-distribution $\sim F(N, T-N-1)$, where N is the number of assets and T is the number of time series observations on the underlying asset returns.

H_0 : Portfolio is efficient

The decision rule to reject H_0 is: Rej. H_0 , iff. $F(X_F, N, T-N-1) < \alpha$ threshold p-value

For the two portfolios discussed in Panel B of Table 5 the various parameters required to determine the GRS statistic can be seen in the table below:

	Tangency Portfolio (*)	Test Portfolio (p)	
mean, r	9.37	11.58	
r_f	1.72	1.72	
sigma, σ	7.54	10.05	
$\theta=(r-r_f)/\sigma$	1.014	0.981	
GRS - W	0.033		
N	6	No. of Assets	
T	448	No. of Weekly Intervals	
X_F	2.455		
p-value	6.2 7E-49	Rej. H_0 (Efficiency)	

The GRS test confirms that the test portfolio is not efficient, relative to the tangency portfolio.