The Dispersion of ETF Betas on Financial Websites

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The asset-allocation process has witnessed a subtle evolution in which individual as well as institutional investors have begun using exchange-traded funds (ETFs) as core components of their portfolios. Burton [2008] notes this trend among financial advisors, who are focusing on sector-tracking ETFs when building client portfolios. ETFs have an estimated combined capitalization of about $581 billion and have become popular because they combine the benefits of mutual funds with the flexibility of real-time stock trading, instant diversification, relatively lower fees, significant tax advantages, and short selling. Furthermore, the growth of financial websites has made it possible for millions of investors to review financial characteristics such as betas of capital-market securities at virtually no cost and then decide on actual investments based on such information. Thus, it is important that the betas on derivative securities, such as ETFs that are being provided by brand-name websites, are reasonably accurate and calculated in accordance with established methods.

This article examines the ETF betas as available on four well-known financial websites and test for their dispersion (or lack of convergence). We focus on beta because it is a key measure of systematic risk that is widely used in portfolio decisions. The dataset for the study was constructed by developing a web retrieval program that harvested the ETF betas from the websites and thereafter stored them in a machine-readable dataset. Studies such as Bruner et al. [1998] have studied beta dispersion among vendor-supplied betas. To the best of our information, this is the first study that systematically studies the dispersion of betas as seen on major finance websites. We found that leading sites such as Yahoo! Finance, MSN Money, Morningstar, and Google Finance[1] display betas that significantly misrepresent (though not intentionally) actual levels of systematic risk. These errors could impact the portfolio design of an investor, leading to unintended outcomes. 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." Additionally, we were able to identify the primary reason for the significant variance in beta estimates. The explanation is surprising and not rooted in the traditionally discussed differences that are attributed to interval-window length mismatch or varying frequency of security returns (daily, weekly, or monthly). An implication of the findings is that there is no substitute for verification and cross-validation of financial information, even if it is coming from supposedly well-established sources.

ETF BACKGROUND

The S&P 500 SPDR, introduced in 1993, was the first ETF. As of May 2009, there

were 721 ETFs with about $581 billion in total assets (Investment Company Institute [2009]), including the well-known Diamonds, Spiders, and the Q's on the NASDAQ. Some of the prominent ETF names include Blackrock's iShares, State Street Global Advisors' SPDRs, and Vanguard ETFs.

With so many ETFs to choose from, there are many options that can suit almost any investor's needs. There are domestic, international, and global ETFs. Investors can choose from among ETFs holding stocks, bonds, commodities, real estate, or currencies. There are ETFs that focus on specific sectors of the market. There are ETFs that short the market, with or without leverage, and some that are being actively managed as well.

BETA ESTIMATES

Sharpe-Lintner-Black's CAPM Beta is a key measure of volatility that allows investors to gauge the amount of risk a security has relative to the overall market, and then to determine their portfolio allocations. Sharpe received a Nobel Prize in 1990 for this pioneering work, yet beta has been the subject of continuous debate. Graham and Harvey [2001] find that 70% of practitioners look to the traditional CAPM beta for a measure of systematic risk and that it remains the choice measure for assessing risk. Betas are more relevant for portfolio risk assessment than for single securities, because unsystematic risk is mostly diversified away. ETFs, by design, are portfolios of securities that have built-in diversification. Using beta, investors can tailor the overall risk of their portfolios to suit their individual risk-return preferences. In addition, advanced strategies such as market-neutral hedged portfolios are based on security betas. An incorrect estimation of an asset beta, such as one arising out of a wrong choice of the market proxy, can impact the neutrality of a portfolio and have unintended consequences, such as an imbalance in the net portfolio exposure.

Bruner et al. [1998] found that vendor-provided betas[2] were significantly different from each other. In a current working paper, Fernandez [2009] reports that about 30% of university professors use website-provided betas in their work; he also did a spot check on the betas of three prominent companies and found them to be quite different, depending on the web source. Such ongoing research provides additional motivation to systematically check for beta dispersion on finance websites.

Beta shows the overall movement of a security or portfolio relative to the market, and it is derived by examining a sample of historical returns. The OLS beta for individual securities is estimated with the standard market model, using excess returns relative to the risk-free rate:

$$(r_i - r_f) = \alpha_i + \beta_i (r_M - r_f) + e_i \quad (1)$$

where r_i is the return on security i, r_M is the return on the market, r_f is the risk-free rate of return, β_i is the calculated beta coefficient, α_i is the intercept term, and e_i is the residual term. The beta of a portfolio is simply the weighted average of the betas of the individual securities that make up the portfolio, where the weights are the percentage of money invested in each security.

More commonly, the regression equation for the calculation of beta does not consider excess returns and simply regress the raw security returns against those of the market. Since the periodic risk-free rate is generally fairly close to zero and subtracted from both sides of the equation, this simplification makes little practical difference, and the format of the equation is as follows:

$$r_i = \alpha_i + \beta_i (r_M) + e_i \quad (2)$$

We calculated ETF betas using the methodologies of both Equations (1) and (2) but present only the results for the latter case, since it is more commonly used in practice and there were only trivial differences in the two sets of estimates. Our proxy for the market was the S&P 500 Index, and our proxy for the risk-free rate was the 3-month Treasury Bill rate. We employed monthly returns with a minimum estimation window of 24 months and a maximum estimation window of 36 months.

The practical application of the theory behind beta has presented numerous problems. Theory calls for the use of an all-encompassing market measure, while in practice the S&P 500 Index, which captures just 500 large stocks, has been widely used. This is an area that has long been debated, going back to Roll [1977]. The CAPM formulation offers no suggestions on the length of the estimation window to be used in calculating beta, but the matter has been examined by Smith [1980], Hawawini [1980], and Groenewold and Fraser [2000]. Likewise, there is no theoretical case for whether the observations for beta calculations should be daily, weekly, monthly, or some other interval of returns. There are certainly practical issues associated with the selection, which have been

examined by Hawawini and Vora [1980], Corhay [1992], Levy, Guttman, and Tkatch [2001], Ho and Tsay [2001], and Agrrawal and Clark [2007].

This article's purpose is to establish whether the ETF betas as seen on financial websites are reasonably close to those estimated by the application of the market model as shown in Equation (2) above. While we did expect to find some minor differences in beta estimates from different data providers, what we found was that there are significant differences in the betas and that they are attributable to none of the above-mentioned reasons. In the following sections we discuss the extent, basis, and cause of these beta divergences.

DATA

There are currently more than 700 ETFs, many of them having relatively small market capitalizations and/or limited histories. About half of today's ETFs were introduced after 2006. To narrow our examination to the more significant and liquid ETFs, we chose to examine ETFs with asset values of $100 million or more as of September 2008. This screen narrowed the field of ETFs to 331. After harvesting the betas for all of them, from each of the 4 websites, we then eliminated those ETFs that had less than two years of history, to ensure that we would have at least 24 monthly observations for our own beta calculations. This resulted in a final sample of 232 ETFs. The sample is composed of 155 U.S. equity ETFs, 59 international or global ETFs, 6 commodity ETFs, 6 foreign-currency ETFs, and 6 bond ETFs.[3] All betas are as of September 12, 2008, and were retrieved from the following four financial websites: Yahoo! Finance, MSN Money, Morningstar, and Google Finance. This was accomplished through the application of a web-retrieval algorithm that was developed for the study and by creating a machine-readable dataset supplemented by manual entries.

Yahoo! Finance reported betas for 154 of our sample of 232 ETFs. Most, but not all, of the omissions appear to be due to the underlying return data series being less than three years, since Yahoo! Finance shows betas for "3 years," "5 years," and even "10 years." Yahoo! Finance's risk measures are provided by Morningstar, but the figures appear to lag the numbers shown at Morningstar by a month. For Morningstar we had a total of 157 observations. MSN Money had betas for all 232 ETFs in our sample. Google Finance had betas for all but six of our sample.

RESULTS

First, we examine the set of published betas for Yahoo! Finance, MSN Money, Morningstar, and Google Finance (henceforth collectively referred to as web-betas) as retrieved from their websites. Thereafter, we compare them against our standard S&P 500 beta calculations (utilizing Equation (2), and henceforth referred to as our S&P 500 betas). To identify deviations of the various beta estimates and establish the statistical significance of the divergences, we look at standard statistical tests such as paired t-tests, the non-parametric sign test, paired correlations, and scattergrams.

Descriptive statistics for the dataset are provided in Exhibit 1. The large "maximum" values of betas from three of the sites (betas with values of more than 12) and the five-times-higher standard deviation of the web-betas (2.27 vs 0.45), compared to the dispersion of our S&P 500 betas, are the first signs of some underlying problem with the online estimates. On an aggregate basis, the average of all the web-betas is 1.31 versus the average of 1.02 that we estimate ourselves.[4]

We observe negative correlation coefficients between the S&P 500 betas and web-betas of Yahoo! Finance, MSN Money, and Morningstar, as shown in Exhibit 2 (correlation r(x, y)), and all three have p-values less than 0.00466. Typically we would expect a strong positive correlation between the beta vectors on the same set of securities despite them being from different sources. While we do not see a negative correlation of the S&P 500 betas

EXHIBIT 1
Descriptive Statistics for All Betas (Web-Betas and S&P 500 Betas)

	Valid N	Mean	Minimum	Maximum	Std.Dev.
Yahoo! Finance	154	1.24	0.49	**12.85**	1.31
MSN Money	232	1.68	-0.11	**32.14**	3.82
Google	226	1.03	-0.26	2.11	**0.34**
Morningstar	157	1.23	0.49	**12.43**	1.26
Our S&P 500 betas	232	**1.02**	-0.34	2.78	**0.45**
All web-betas	769	**1.31**	-0.26	32.14	**2.27**

Notes: This table indicates that web-betas have values and dispersion of a magnitude greater than our S&P 500 betas.

EXHIBIT 2

Correlations of Web-Betas vs S&P 500 Betas, for All Observations (Includes Non-Equity Assets, International, and Google 1.0's)

	r(x,y)	r^2	t-value	p-value	N
SP500_Beta vs Yahoo! Finance	**-0.23**	0.05	-2.93	***0.0038987***	154
SP500_Beta vs MSN Money	**-0.32**	0.10	-5.18	***0.0000005***	232
SP500_Beta vs Google	0.64	0.41	12.52	***0.0000000***	226
SP500_Beta vs Morningstar	**-0.22**	0.05	-2.87	***0.0046608***	157

Notes: Instead of the very strong pairwise correlations that one would typically expect, we see in Exhibit 2 negative correlations that are also statistically significant. This should not be the case.

EXHIBIT 3

Paired t-tests of Web-Betas vs S&P 500 Betas, for All Observations (Includes Non-Equity Assets, International, and Google 1.0's)

	t-value	df	p-value	N
SP500_Beta vs Yahoo! Finance	**-2.33**	384	***0.0205456***	154
SP500_Beta vs MSN Money	**-2.62**	462	***0.0090269***	232
SP500_Beta vs Google	-0.25	456	0.8005599	226
SP500_Beta vs Morningstar	**-2.34**	387	***0.0195663***	157

Notes: Exhibit 3 confirms that the web-betas are significantly different from the classic S&P 500 betas, except for the Google betas.

EXHIBIT 4

Non-Parametric Sign Test for Differences between Web-Betas and S&P 500 Betas, for All Observations (Includes Non-Equity Assets, International, and Google 1.0's)

	Z-value	p-level
SP500_Beta vs Yahoo! Finance	3.234	***0.001222***
SP500_Beta vs MSN Money	2.105	***0.035253***
SP500_Beta vs Google	0.998	0.318384
SP500_Beta vs Morningstar	2.962	***0.003053***

Notes: Exhibit 4 confirms the results of Exhibit 3, without making any assumptions about the distribution of the underlying data.

with Google betas, the correlation is only 0.64. A paired t-test confirms that the full set of S&P 500 betas is collectively different from that found on Yahoo! Finance, MSN Money, and Morningstar, with all p-values less than 0.0205 (Exhibit 3). The non-parametric Sign test[5] shows significance in paired differences for the S&P 500 versus Yahoo! Finance, the S&P 500 versus MSN Money, and the S&P 500 versus Morningstar beta pairs, with all p-levels less than 0.035 (Exhibit 4). From the same panel, a lack of statistical significance (p-value 0.318) for differences between Google and S&P 500 betas can be seen. This is most likely linked to the fact that 75 of the observed 226 Google betas are exactly 1.0, thus reducing the variation within the group and impacting the discernability of the test.

Having noted statistically significant differences in the web-betas versus our S&P 500 betas, we now discuss the drivers behind these divergences. We discuss the source of these divergences using Exhibits 5 through 9, where betas are grouped by the ETF category: US Equity, International/Global Equity, Bond, Commodity, and Currency.

Google Betas Equaling 1.0

We first examine the 152 US Equity betas from the Google Finance site. About a third of these, or 47, had published betas of exactly 1.0. Exhibit 5 presents a sampling of those web-betas and our S&P 500 betas for the 47 ETFs.[6] Where Google has 1.0's, our calculations ranged from a low of 0.56 to a high of 2.78. MSN Money's 1-year beta estimates for the same group of stocks ranged from a low of 0.35 to a high of 3.10. Unfortunately, Google does not offer on its website any explanation of its beta estimation process. The presence of securities with betas of 1.0 implies that separate best-fit indexes are being used as the market proxy, resulting in an exact linear fit. Google could be calculating betas for the Vanguard Value ETF (VTV), for example, by using a value index as the assumed market instead of the broader S&P 500. As a contrast, Morningstar presents separate beta calculations with a "standard index" and a "best-fit index."

Beta Problem with International and Global ETFs

Exhibit 6 presents a sample of the betas of the 59 international and global equity ETFs. Again, about a third (18 in all) of Google's betas were exactly equal to 1.0. Google's betas on the ETFs of Switzerland, the U.K., and

EXHIBIT 5

Comparative Betas of U.S. Equity ETFs where Google Assigned a Beta of 1 (a Sample from 75 Observations)

		Beta Source				
Ticker	ETF Name	Yahoo! Finance	MSN Money	Google Finance	Morningstar	Index S&P 500
IHE	iShares Dow Jones U.S. Pharmaceutical	...	0.56	1.00	...	0.77
NYC	iShares NYSE 100	1.01	1.00	1.00	1.00	1.06
VTV	Vanguard value	1.01	0.95	1.00	1.01	1.01
...	...	...	...	...	...	...
XME	SPDR S&P Metals & Mining	...	0.44	1.00	...	0.86
XOP	SPDR S&P Oil & Gas Explor & Product	...	0.76	1.00	...	0.77
XRT	SPDR S&P Retail	...	0.89	1.00	...	0.95
	Average (based on full sample)	**0.98**	**1.09**	**1.00**	**1.00**	**1.10**

Notes: Google provides no explanation of its beta calculations. All betas as of September 12, 2008.

EXHIBIT 6

Comparative Betas of International and Global ETFs (a Sample from 59 Observations)

		Beta Source				
Ticker	ETF Name	Yahoo! Finance	MSN Money	Google Finance	Morningstar	Index S&P 500
EEM	iShares MSCI Emerging	1.52	1.57	1.75	1.55	1.60
EFA	iShares MSCI **EAFE**	0.99	0.99	**1.00**	0.99	**1.10**
EWL	iShares MSCI **Switzerland**	0.68	0.56	**1.00**	0.69	**0.79**
...	...	...	...	...	...	...
EWU	iShares MSCI **United Kingdom**	0.94	0.95	**1**	0.92	**1.05**
FXI	iShares FTSE/Xinhua China 25	1.91	2.54	1.62	1.94	2.09
IXN	iShares S&P Global Technology	1.34	1.42	1.50	1.34	1.44
	Average (Based on full sample)	**1.16**	**1.15**	**1.13**	**1.16**	**1.25**

EXHIBIT 7

Comparative Betas of Bond ETFs

		Beta Source				
Ticker	ETF Name	Yahoo! Finance	MSN Money	Google Finance	Morningstar	Index S&P 500
LQD	iShares GS $ InvesTopTM Corporate Bond	1.20	0.80	-0.07	1.19	0.08
SHY	iShares Lehman 1-3 Year Treasury Bond	0.49	0.79	-0.04	0.49	-0.06
TLT	iShares Lehman 20 Year Treasury Bond	**2.72**	**2.53**	-0.24	2.73	**-0.25**
IEF	iShares Lehman 7-10 Year Treasury Bond	1.69	2.07	-0.20	1.70	-0.20
AGG	iShares Lehman Aggregate	**1.01**	**1.04**	...	1.01	**-0.02**
TIP	iShares Lehman TIPS Bond	1.53	1.79	-0.15	1.49	-0.19
	Average	**1.44**	**1.50**	**-0.14**	**1.44**	**-0.11**

Notes: The dispersion of bond ETF betas is large; notice the average of –0.11 for our S&P 500 betas compared to average values of 1.44 or greater. Are Treasury bonds 44% more volatile than the S&P 500? There is a problem here.

EXHIBIT 8

Comparative Betas of Commodity ETFs

		Beta Source				
Ticker	ETF Name	Yahoo! Finance	MSN Money	Google Finance	Morningstar	Index S&P 500
IAU	iShares COMEX Gold	11.85	27.34	-0.18	11.42	-0.07
GSG	iShares GSCI Commodity	...	0.23	1.00	...	-0.32
SLV	iShares Silver	...	30.83	1.00	...	-0.14
GDX	Market Vectors TR Gold Miners	...	32.14	1.00	...	-0.01
GLD	SPDR Gold	**12.85**	**27.79**	0.41	**12.43**	**-0.06**
USO	United States Oil	...	0.69	1.00	...	-0.24
	Average	**12.35**	**19.84**	**0.71**	**11.93**	**-0.14**

Notes: The dispersion of commodity ETF betas is large; notice the average of –0.14 for our S&P 500 betas compared to average values of 11 or greater. Betas greater than 11—do they even mean anything?

EXHIBIT 9

Comparative Betas of Currency ETFs

		Beta Source				
Ticker	ETF Name	Yahoo! Finance	MSN Money	Google Finance	Morning-star	Index S&P 500
DBV	PowerShares DB G10 Currency Harvest	...	1.05	1.00	...	0.38
FXA	Rydex CurrencyShares Australian Dollar	...	8.22	1.00	...	0.21
FXB	Rydex CurrencyShares British Pound Sterling	...	3.10	1.00	...	0.05
FXC	Rydex CurrencyShares Canadian Dollar	...	2.88	1.00	...	0.42
FXE	Rydex CurrencyShares Euro Currency	...	5.80	1.00	...	-0.04
FCF	Rydex CurrencyShares Swiss Franc	...	**10.56**	**1.00**	...	**-0.34**
	Average	...	**5.27**	**1.00**	...	**0.34**

Notes: The magnitude of currency web-betas is very high compared to the more realistic average of 0.11 that we estimate. There is a problem here as well.

EAFE are all equal to 1.0 compared to our calculations of 0.79, 1.05, and 1.10, respectively. This again supports the notion that Google was using best-fit indexes, such as country-based indexes, as its market measure.

The issue is not as pronounced as noted below with non-equity ETFs, but the betas of international ETFs provided by Yahoo! Finance, MSN Money, and Morningstar all differ from our S&P 500 beta calculations. There are likewise numerous issues with global ETFs. The international beta calculations from these websites all employ the MSCI-EAFE as the market index instead of the S&P 500. There does not appear to be any consistency in how the websites select the market indices for global ETFs. The resulting differences that we noted in the web-betas and our calculated betas were relatively small because the S&P 500 Index and the MSCI-EAFE have been highly correlated in recent times. If this relationship breaks down in the future, a divergence of the beta calculations will follow.

Beta Problem with Non-Equity ETFs

We isolated the remaining anomalies, limited primarily to non-equity ETFs. The betas for the ETFs of bonds, commodities, and currencies are presented in Exhibits 7, 8, and 9. This is where some of the largest divergences are occurring, which can be seen as the outliers in the Exhibit 12 scattergram.

Betas for the six bond ETFs[7] in our sample are shown in Exhibit 7. Returns on bond instruments tend to have low correlations with the equity market

(Connolly, Stivers, and Sun [2005]). We find that the sample average for our S&P 500 Bond betas is −0.11, implying considerable diversification benefits of holding bonds. Our bond ETF estimates were, however, not at all in line with the various web-betas, except for Google, which has a bond ETF average of −0.14 (see Exhibit 7). For the iShares Lehman 20 year Treasury ETF (TLT), for example, we calculated a beta of −0.25, which contrasts sharply with betas of 2.72, 2.53, and 2.73, as available on Yahoo! Finance, MSN Money, and Morningstar, respectively. The bond web-betas, on average, differ by a factor of 10 compared to our S&P 500 betas, and also have the opposite signs. Such dispersion can make portfolio risk estimation essentially meaningless and asset allocation difficult.

Exhibit 8 shows the betas of the six commodity ETFs in our sample. We expected web-betas to be close to zero for gold-based ETFs such as the Gold Bullion SPDR (Hillier, Draper, and Faff [2006]), but what we discovered was something quite different. Our beta estimate of −0.06 for the SPDR Gold ETF (GLD) differed significantly from the Yahoo! Finance beta of 12.85 beta and the MSN Money beta of 27.79. The web-betas of all precious-metal ETFs differed by large magnitudes, averaging about 14 versus our average S&P 500 beta of −0.14.

Finally, Exhibit 9 presents the betas of the six currency ETFs in our sample, which also reveal several notable anomalies. Google is consistent in assigning 1.0's across the board, while Yahoo! Finance and Morningstar do not present betas for any of these ETFs. Our figures differ down the line compared to MSN Money. The average of the currency betas as available on the MSN Money site is 5.27, compared to the average of 0.11 for the betas we calculated for the same ETFs relative to the S&P 500. As an example, the beta the MSN Money assigned Swiss Franc ETF is 10.56, while we calculate −0.34.

The large variation in the bond, commodity, and currency ETF betas is due to an inconsistent application of market proxies in calculating betas. Financial websites utilize either the S&P 500 Index or the Lehman Aggregate Bond Index as the market proxy for bond ETFs. MSN Money uses an MSCI-EAFE index for gold and silver commodity ETFs, but it uses the S&P 500 Index for the iShares Commodity and the U.S. Oil ETF. And Morningstar employs either the three-month LIBOR or the S&P 500 Index for commodities. MSN Money, which clearly identifies the index used for every other ETF category, inexplicably does not do so for currency ETFs.

Reduced Dispersion of Betas upon Exclusion of Problem Assets

The magnitude of the divergences observed in the beta estimates of non-U.S. and non-equity ETFs suggests that these differences are linked to the choice of the index used as a proxy for the market portfolio. What happens when asset classes that were most prone to estimation problems are excluded? Exhibits 10 and 11 report the results of correlations and pairwise t-tests between our S&P 500 betas and the web-betas, *after* excluding all non-equity ETF betas and Google beta 1.0's. The result is quite different, and considerable convergence between the web-betas and our S&P 500 betas can be seen. The correlations for three of the four primary websites investigated now exceed 0.90 (p-value = 0.00000). The correlation of the remaining Google betas with our S&P 500 betas improve to 0.82 (p-value 0.00000). Furthermore, none of the reported p-values for paired differences in means is lower

EXHIBIT 10

Correlations of Web-Betas vs S&P 500 Betas, for a Partial Set of Observations (Excludes Non-Equity Assets and Google 1.0's)

	r(x,y)	r^2	t-value	p-value	N
SP500_Beta vs Yahoo! Finance	**0.95**	0.90	34.07	**0.0000000**	137
SP500_Beta vs MSN Money	**0.90**	0.82	25.70	**0.0000000**	149
SP500_Beta vs Google	0.82	0.67	16.87	**0.0000000**	144
SP500_Beta vs Morningstar	**0.95**	0.90	34.77	**0.0000000**	137

Notes: Most correlations are greater than 0.90, implying that the beta sets, after the exclusion of the problem assets, are quite similar. Contrast this exhibit with Exhibit 2, where the correlations are negative. Exhibit 10 should be the typical case.

than 0.4279297, implying no significant between-group divergences (Exhibit 11). This result indicates that the problem of beta dispersion for ETFs is primarily limited to certain asset classes. This can be seen visually as well in Exhibit 13, where all of the web-betas, excluding the betas of the ETFs based on non-equity assets and Google 1.0's, as well as international stocks, are plotted versus our S&P 500 betas. We see a contrasting scattergram from that in Exhibit 12—one that would be considered typical once these problem groups are expunged; now most points lie on a 45-degree line and are within the 95% ellipsoid. The extent of beta dispersion can also be seen in Exhibit 14, where we show that about 13% of all the ETF web-betas differ by an absolute magnitude of 25% or higher in their beta values, relative to our S&P 500 betas. Such dispersion can alter the risk assessment of an investor's portfolio and lead to unexpected outcomes arising out of faulty portfolio rebalancing or incorrect asset exposure.

Cause and Implication of Index Mixing: A Case for Multiple Mapping of Betas

A broad market index, such as the S&P 500 Index, is appropriate for calculating betas to measure the systematic risk of securities and portfolios for U.S. investors. The reason that Morningstar, for example, uses more focused indexes to calculate betas is that its ultimate goal is not to determine a measure of systematic risk, but rather to determine alphas as a measure of portfolio performance. If one is gauging the performance of a bond investment, the S&P 500 Index is not an appropriate benchmark, but the Lehman Aggregate Bond Index may be. Using Equations (1) or (2), if the returns of a benchmark portfolio are used in place of the broad market returns, α_i measures excess returns on the part of the investment. Sources such as

EXHIBIT 11

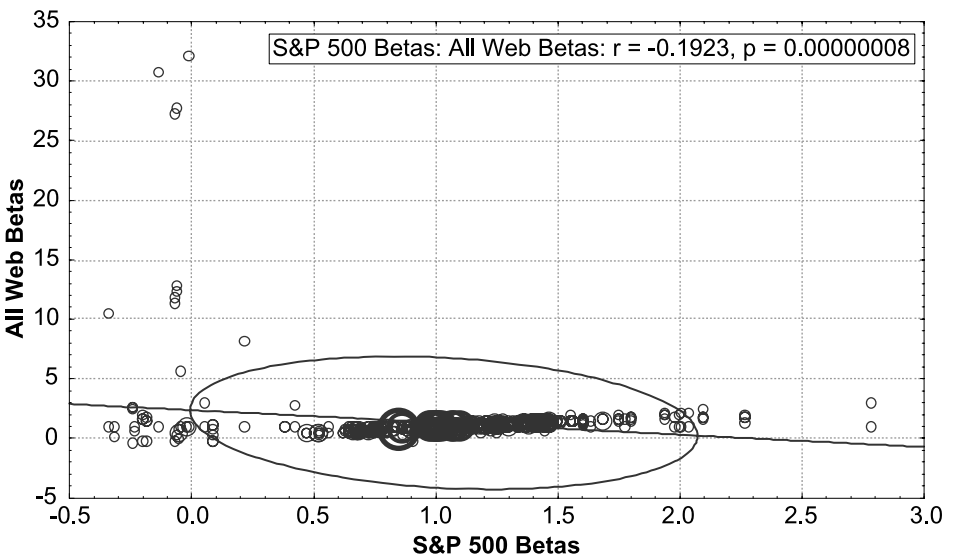
Paired t-tests of Web-Betas vs S&P 500 Betas, for a Partial Set of Observations (Excludes Non-Equity Assets and Google 1.0's)

	t-value	df	p-value	N
SP500_Beta vs Yahoo! Finance	0.77	284	0.4420672	137
SP500_Beta vs MSN Money	0.79	296	0.4279297	149
SP500_Beta vs Google	0.38	291	0.7035208	144
SP500_Beta vs Morningstar	0.69	284	0.4917723	137

Notes: No p-value is less than 0.05, implying that the beta sets, after the exclusion of the problem assets, are no longer significantly different. That should be the typical case.

EXHIBIT 12

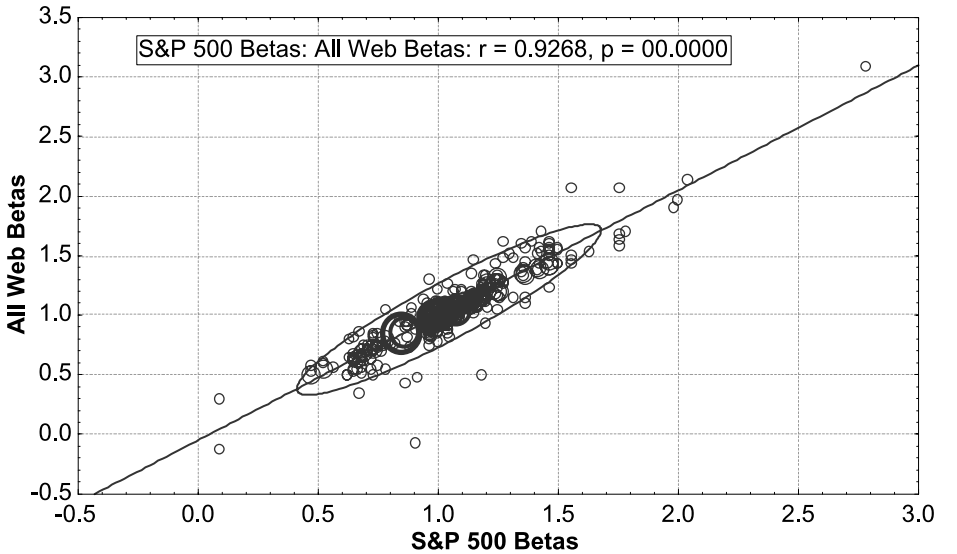
Scattergram of All Web-Betas versus the S&P 500 Betas



Notes: Most of the betas lie within the 95% ellipsoid, but there are a number of ETFs whose web-betas do not correspond with those of the S&P 500 betas. This article identifies these ETFs and finds that they are not randomly distributed, but rather belong to certain asset classes only.

EXHIBIT 13

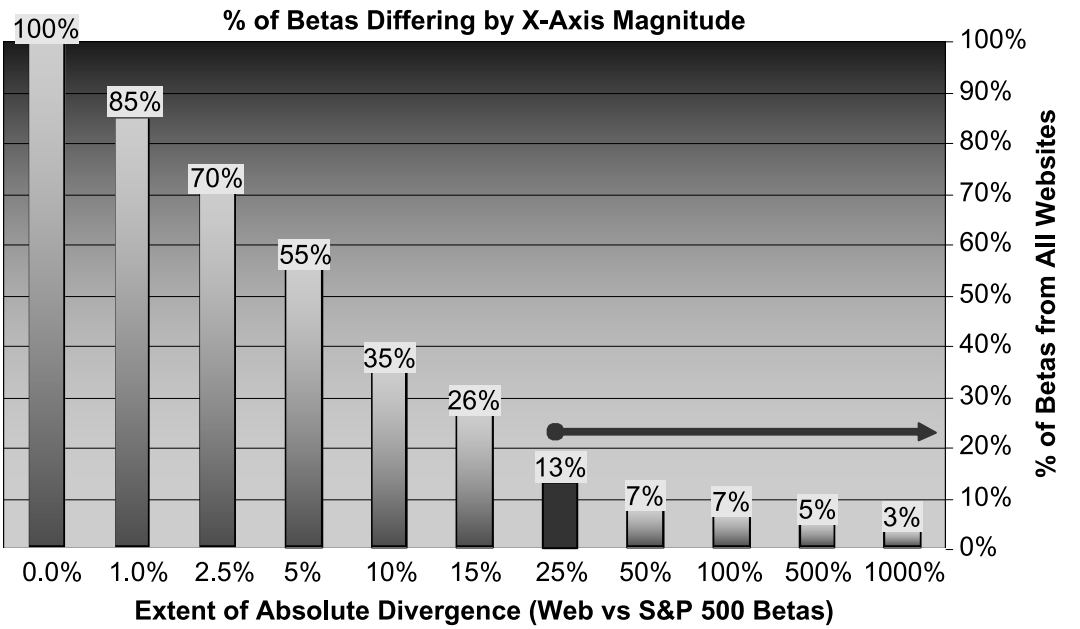
Scattergram of All Web-Betas versus the S&P 500 Betas (Excluding the Problem Betas of Non-Equity ETFs, International ETFs, and Google 1.0's)



Notes: This scattergram is more typical looking—it is compact and most observations plot on a 45-degree incline. It indicates a diminished dispersion of betas as a result of excluding the problem ETF groups.

EXHIBIT 14

Distribution of Web-Betas by Extent of Divergence—Relative to the S&P 500 Beta



Notes: About 13% of all the ETF betas in our combined sample set of 769 individual web-betas have an absolute divergence of 25% or higher in their beta values, relative to the classic S&P 500 betas. In fact, 5% of the web-betas differ from the classic S&P 500 betas by 500% or more.

Morningstar are interested in identifying positive alpha sources, which drives traffic to their sites.

Morningstar and some other sites present "betas" that are most likely generated as a by-product of the calculation of performance-measuring alphas. If the benchmark used for performance-evaluation purposes is something other than a broad market index that encompasses U.S. equities, the betas that are calculated in the process will obviously not be appropriate measures of systematic risk. For U.S. equities, the S&P 500 Index is a widely recognized benchmark portfolio, so the betas calculated during the alpha-generating process also double up as the correct measure of systematic risk. The problem obviously manifests itself only for categories other than U.S. equity.

While this alpha-beta issue may be obvious to sophisticated investors, financial websites exacerbate the issue and mislead uniformed investors by providing the traditional market risk definition of beta. Morningstar, for instance, suggests that a portfolio invested primarily in gold would be expected to have a low beta. The S&P 500 beta of −0.06 that we calculate supports this contention, but Morningstar's reported beta of 12.43 certainly does not.

As noted earlier, a portfolio beta is simply the weighted average of the betas of the securities that comprise the portfolio. Since all of these ETFs trade on U.S. exchanges, the potential implication of index mixing in calculating betas is that when an investor holds a set of U.S. ETFs, a portfolio beta is impossible to estimate (or would be meaningless) since the risk is not calibrated against a unique market (Roll [1977]). Yet a well-diversified investor would witness portfolio volatility against a broad market index, such as the S&P 500. As noted earlier, we used the S&P 500 index as our market proxy for all of the ETF betas, irrespective of which asset class they belonged to or whether they were country ETFs. If an ETF is traded on U.S. exchanges, it implies that it is a potential portfolio element for a diversified U.S. portfolio. It could be argued that the beta of a bond ETF should be calibrated against a bond index, but since ETFs often form the core of diversified portfolios, the estimation of beta would be rendered useless if the underlying ETFs do not have the same market proxy.

It would not be difficult for these well-resourced sites to produce multiple betas mapped to non-U.S. or non-equity-based ETFs, where one of the betas is always against the standard S&P 500 index. Yahoo! Finance, for example, currently makes available three betas, estimated over the 3-, 5-, and 10-year periods; obviously they have the technology to produce alternate betas. Likewise, Morningstar provides two betas for each ETF, one versus the "standard index" and the other versus the "best fit index." This is a case where more information is apparently better than less.

CONCLUSIONS

This article documents significant differences in the beta estimates of ETFs as available on some leading financial websites. We attribute the variation in betas primarily to the choice of the market index used for beta estimation. We found that varying market indices are being deployed for all of the ETF categories other than U.S. equity. This not only results in different beta figures for international, global, bond, commodity, and currency ETFs, it also impacts the interpretation and application of the resulting betas. A U.S. investor who primarily holds U.S.-traded assets can no longer look at a beta and estimate whether the security in question has above-average or below-average market risk, because the underlying index could be a sector index, the LIBOR or the MSCI EAFE index. Furthermore, a portfolio beta calculated with these reported web-betas would have little meaning.

Additionally, we found that the differences in betas due to the assumed market indexes are much more pronounced for bond, commodity, and currency ETFs (Exhibit 13). The web-betas for these asset classes are virtually unusable, with some betas in the double digits (Exhibits 7, 8, and 9). Google Finance has a unique problem in itself, where about a third of its betas are exactly equal to 1.0, effectively putting them on par with the risk of the broad U.S. equity market. Apparently, they also have the problem of multiple market proxies as the benchmark index. We determined that these differences are statistically significant by deploying standard parametric and non-parametric tests (Exhibits 2, 3, and 4). Excluding the class of non-equity and international security-based ETF betas, as well as Google 1.0 betas, resulted in a significant overlap of the remaining web-betas with the classic S&P 500 market betas, which we estimated (Exhibit 13). Furthermore, we were able to isolate these problem securities and thus suggest a solution for how to produce meaningful beta estimates (via multiple mapping). Finally, it is incumbent on the users of financial information as seen on websites, whether they be

academics (Fernandez [2009]), practitioners, or casual investors, to verify and do their own due diligence before incorporating the seemingly "free" information into their portfolios. This article has shown that while the Internet has done a great job in disseminating expensive processed information (in this case market betas), there is still considerable room for improvement and refinement, and that what comes out of a black box still needs to be verified.

ENDNOTES

[1]A report by Nielsen/NetRatings released in September 2007 indicates that some of the above-mentioned sites had an aggregate of over 40 million unique visitors for the month of August 2007.

[2]Published betas from Bloomberg, Value Line, and Standard & Poor's.

[3]The number 6 was not by design or intent. It reflects the fact that there is a limited number of ETFs in the non-equity asset classes, even though some are very liquid with large market capitalizations.

[4]Readers are encouraged to visit these websites and, for example, look for the beta of GLD (Exhibit 8): http://finance.yahoo.com/q/rk?s=GLD, http://moneycentral.msn.com and http://www.google.com/finance?q=GLD. The discrepancies in the beta values on the websites will begin to surface.

[5]The Sign test, a nonparametric alternative to the t-test, tests the hypothesis that the scores for any two variables are drawn from the same distribution.

[6]The full list of 155 US Equity ETF betas is not shown to preserve space; they are available from the authors. All web-betas are as of September 12, 2008.

[7]Most of the ETFs are equity based. The number of Bond, Currency and Commodity ETFs is relatively small and we have included all of them as long as they meet our primary data availability screens.

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