

The IBS Effect: Mean Reversion in Equity ETFs

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Abstract

I investigate mean reversion in equity ETF prices at the daily frequency by employing a simple technical indicator, Internal Bar Strength (IBS). IBS is based on the position of the day's close in relation to the day's range: it takes a value of 0 if the closing price is the lowest price of the day, and 1 if the closing price is the highest price of the day. The IBS effect may be related to intraday over-reactions to news or market movements, which are then "corrected" the next day.

I use the IBS indicator to successfully forecast close-to-close returns with statistically and economically significant results for most instruments. By separating daily bars into five buckets depending on the IBS value of that day, I show that low IBS values are associated with high returns, while high IBS values are associated with low returns. Average returns when IBS is below 0.20 are .35% while average returns when IBS is above 0.80 are -0.13%. This effect has been present in equity ETFs since the early 90s and has been highly consistent through time.

The relationship between IBS and close-to-close returns is not linear, but instead based on threshold levels (approximately 0.4 and 0.9) below and above which the indicator has predictive power. The IBS effect tends to be stronger at times of high volatility, especially on the short side: it has no predictive ability for shorts in low volatility environments. Similarly, IBS predictive ability is stronger following high-range days. The effect is also slightly stronger in bear markets (defined as periods with negative 200-day returns); short side returns are greater in bear markets, and vice versa for bull markets. Volume also plays a role, but only for U.S. equity ETFs: the IBS effect completely disappears on low volume days for them. Finally, it is also much stronger than average on Mondays (lending credence to the popular concept of "Turnaround Tuesday") and weaker on Fridays.

The effect only seems to exist in the U.S., as local equity index ETFs in France, Australia, Germany, Spain, Switzerland, Taiwan, and the U.K. either do not exhibit it at all, or do so to a much smaller degree. Currency returns are not the source of this discrepancy, however. The statistical arbitrageurs who trade U.S.-listed ETFs for foreign equities when their local exchanges are closed may be playing a significant role.

The IBS effect can be exploited as part of a profitable trading strategy, even after commissions and other transaction costs. While using IBS alone is difficult due to transaction costs, it is possible to combine the IBS effect with longer-term mean reversion. A simple strategy based on the RSI indicator can be greatly improved by taking into account IBS: for the ETFs in the sample, adding an IBS filter improves total returns by almost 10 percentage points while decreasing time spent in the market by almost 45%.

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Introduction

Equity indices exhibit mean reversion in daily returns. A simple and powerful way to capture this effect is the Internal Bar Strength technical indicator, which simply relates the closing price of a security to its daily range. When the closing price is near the bottom of the day's range, close-to-close returns on the following day tend to be higher than average, and vice versa.

The source of these mean reverting tendencies is difficult, if not impossible, to establish and is beyond the scope of this paper. Trading costs are extremely important when it comes to short term strategies, but the magnitude of the IBS effect, combined with the fact that it shows up in some of the most liquid securities in the world, is more than enough to overcome them. The IBS effect can also be combined with other trading strategies to enhance their returns.

Literature Review

There has been no treatment of the IBS effect specifically in the academic literature. Related issues such as intraday overreaction to news, and negative autocorrelation in daily returns have received some coverage, however.

Klößner et al. (2012) use measures derived from OHLC data, in a Brownian motion context, to test for intraday overreaction in the components of the S&P500 and XETRA-DAX indices. They find significant evidence for overreaction to bad news. Kudryavtsev (2012a;b) follows a similar, cross-sectional, methodology and applies it to close-to-close and overnight returns of DJIA constituents, finding evidence of overreaction and reversal. Conrad et al. (1994), expanding on the work of Lehmann (1990), find evidence of overreaction (and subsequent negative autocorrelation, i.e. reversal) in the returns of individual securities with relatively high volume.

Data and Methodology

Data

The requirement of reliable OHLC values precludes the use of index or mutual fund data. As such, the analysis is constrained to ETFs and thus a relatively short period of time. The data used covers the period from the inception for each ETF to 5/12/2013.

Daily ETF data is sourced from CSI. Descriptions of the ETFs used can be found in Table 1, while descriptive statistics of their daily returns can be found in Table 2.

Methodology

IBS at time t is calculated as follows:

$$IBS_t(n) = \frac{Close_{t-i} - Low_{t-i}}{High_{t-i} - Low_{t-i}}$$

It takes values from 0 (if the close is the lowest value of the day) to 1 (if the close is the highest value of the day). It can be thought of as a 1-period Stochastic Oscillator.

Results

Equity Index ETFs

The distribution of IBS values is U-shaped: extreme high and low values appear more frequently than those in the middle of the distribution (see Figure 1). The shape of the distribution is an expected property of the random price process. Due to the long-term positive bias of returns, there is also a slight tendency for the closing price to be above the middle of the range: 54.5% of IBS values are above 50%.

In order to examine the predictive power of the IBS indicator, I separate days into 5 "buckets", based on the day's IBS value (i.e. IBS values between 0%-20% is the bottom bucket, etc.), and then average close-to-close returns for each bucket and ETF. The results can be seen in Table 3. There is an economically significant difference between low and high IBS values. For most ETFs, the returns following top and bottom bucket IBS readings are statistically significantly different from the average day at the 1% confidence level. Bottom-bucket IBS days are followed, on average, by a 38 basis point move upwards, while top-bucket IBS days are followed, on average, by a 14 basis point move downwards.

This asymmetry is an expected result of the long-term upward bias of equity prices. It may also be related to the so-called leverage effect, which leads to overreactions that are larger on the negative side. The top bucket also contains more days, because high IBS readings are the most frequent. As such that bucket is less "selective".

Figure 2 shows average close-to-close returns plotted against IBS for all ETFs. It is clear that the relationship between IBS and close-to-close returns is not linear (and thus does not lend itself to linear regression analysis). Instead there appear to be two "thresholds", below and above which returns deviate significantly from the average, roughly at the .4 and .9 levels.

Table 4 shows the probability of an up day depending on IBS value: the average difference between top and bottom buckets is 11.2%, with statistically significant results at the 1% level for most ETFs.

The IBS effect is highly consistent through time. Table 5 contains returns to a simple IBS strategy (going long when an ETF has an IBS of 0.2 or less, and going short when an ETF has an IBS of 0.8 or more) by ETF and year, showcasing the remarkable consistency of the mean reversion effect.

These ETFs are not hedged against currency fluctuations. As such, it is possible that the IBS effect is due to currency returns and not equity returns. Examining ETFs associated with major currencies (Eurozone, U.K., Japan, Australia, and Canada) I found no evidence of the ETF IBS being related to next-day currency returns, thus rejecting any currency-based explanation for the effect.

Splitting the ETFs by developed/developing economies shows that the IBS effect has similar power in both groups. The difference between close-to-close returns after top and bottom bucket IBS values is 0.570% for developed countries and 0.452% for developing countries.

A trading strategy based on the IBS effect would trade frequently, making transaction costs important. The assets used in this paper are not a homogeneous group; some are ETFs with little volume, where the price impact of large trades would be sizable. On the other hand, the IBS effect is prevalent in U.S. equity indices as well, where both equity and futures markets provide ample liquidity and low transaction costs. Furthermore, trading at the closing auction can be used to avoid the bid-ask spread. As such, transaction costs are not a limiting factor to strategies based on the IBS effect.

Local vs U.S.-based ETFs

Many countries do not have any usable ETFs, or have inadequate data, making this analysis somewhat problematic. The few countries that do have adequate data (France, Austria, Germany, Spain, Switzerland, Taiwan, and the U.K.) either do not exhibit the IBS effect at all, or only to a far smaller degree. In some cases, such as for the German DAX ETF, the effect is even inverted, with the top bucket showing the highest returns. The IBS effect can thus be said to be a U.S.-centric phenomenon. The difference is illustrated with equity curves for each bucket for the U.S.-based and local ETFs in Figures 3 to 9. The reason(s) behind this are unclear, but it is a problem in terms of strategy implementation as trading in the local futures markets is not viable given the fact that the effect only shows up at the end of the U.S. session.

After 2008, a large part of the IBS effect for international ETFs depends on the IBS value of SPY: if the SPY IBS is low, shorting a high IBS international ETF will not work. The same relationship exists on the other side of the spectrum: if SPY IBS is high, going long a low IBS international ETF has significantly lower returns than it would otherwise provide. The actual mechanism of price discovery for international ETFs whose markets are closed is unclear, but it's fertile ground for statistical arbitrageurs. Levy & Lieberman (2013) suggest that country ETFs overreact to S&P 500 price changes during the hours when the foreign exchange is closed.

The Role of Range, Volume, Bull/Bear Markets, and Volatility

To investigate the relationship between the IBS effect and volatility, I calculate 20-day realized volatility for each day, then divide the sample into high volatility (above the median) and low volatility (below the median) days. Table 6 shows average volatility-adjusted close-to-close returns by IBS bucket, separated by volatility regime. It is clear that high volatility is related to increased predictability of returns and a more powerful IBS effect, in particular the high IBS-negative return aspect.

Range tends to be positively correlated with volatility, so I expect similar results. To test the importance of range, I construct a purely backwards-looking measure of relative range, by comparing the day's range against the last 500 days' median range. A value at or above the median is considered a large range day, while a value below the median is considered a small range day. Table 7 contains average raw close-to-close returns by IBS bucket for high and low range days, while Table 8 shows the same returns with a volatility adjustment. As expected, the effect is larger after days with high range, both for high and low IBS extremes.

I also separate the set into bull and bear market environments, based on whether 200-day returns are positive or not. Table 9 contains average raw close-to-close returns by IBS bucket for high and low range days, while Table 10 shows the same returns with a volatility adjustment. The size of the effect is roughly similar in each environment (slightly larger in bear markets), but it is greater in the direction of the overall trend: high IBS readings are followed by larger negative returns during bear markets, and vice versa.

Volume also has some relation to volatility, but less so than range. The volume of the U.S.-based ETFs and the volume in their respective local markets are not necessarily well-correlated, which clearly shows in the results. Table 11 contains average raw close-to-close returns by IBS bucket for high and low volume days, while Table 12 shows the same returns with a volatility adjustment. close-to-close returns for foreign ETFs are virtually unchanged between the high and low volume categories. On the other hand, the difference is extremely important for the U.S. index ETFs: the IBS effect only appears to work on high-volume days. This may be a hint toward the source of the effect.

Day of the Week

Table 13 shows the 1st - 5th IBS bucket difference of average close-to-close returns, sorted by day of the week. The IBS effect is strongest on Monday), giving credence to the popular concept of "Turnaround Tuesday". Tuesday, Wednesday, and Thursday appear to behave similarly, while the the effect is by far the weakest on Fridays. The reasons behind this phenomenon are unclear; Mondays are not more volatile relative to other days.

Skewness

The mean of the returns distribution is not the only aspect that IBS can predict. Skewness also varies significantly between buckets, with low IBS readings being followed by highly skewed returns, and vice versa. As can be seen in Table 14, close-to-close returns after a bottom-bucket IBS day have skewness of 0.65, while top-bucket IBS days are followed by returns with skewness of 0.03. This finding has very useful risk management applications for investors concerned with tail risk.

IBS as Filter

The returns to an IBS-only strategy are both statistically and economically significant. Commissions will greatly decrease the returns and increase the maximum drawdowns, however, making such an approach problematic in the real world. One alternative is to combine the IBS effect with mean reversion on longer timescales and only take trades when they align. A simple demonstration using the Cutler's RSI indicator will show how the IBS effect can be used to boost returns of a swing trading strategy while significantly decreasing the number of trades needed.

Cutler's RSI at time t is calculated as follows:

$$U_t = \max(0, close_t - close_{t-1})$$
$$D_t = -\min(0, close_t - close_{t-1})$$
$$RS_t(n) = \frac{1/n \sum_{i=0}^{n-1} U_{t-i}}{1/n \sum_{i=0}^{n-1} D_{t-i}}$$
$$\text{Cutler's } RSI_t(n) = \begin{cases} 100, & \text{if } \sum_{i=0}^{n-1} D_{t-i} = 0 \\ 100 - \frac{100}{1+RS_t(n)}, & \text{otherwise} \end{cases}$$

I test a simple, long-only strategy that uses the Cutler's RSI(3) indicator:

- Go long at the close if $RSI(3) < 10$
- Maintain the position while $RSI(3) \leq 40$

I then filter these returns by adding an additional rule based on the value of IBS:

- Enter or maintain long position only if $IBS \leq 0.5$

The results can be seen in Table 15. The IBS filter removes approximately 43% of the days that the RSI(3) system spends in market, while increasing total returns by 9.6% on average. Note that when the RSI and IBS strategies align, average close-to-close returns are higher than for either strategy alone. Figure 10 shows compounded equity curves illustrating the returns to the RSI(3) strategy and its filtered version, as applied to the QQQ ETF.

While such a strategy easily beats commissions, there are other constraints on using it at scale: the requirement of executing over a very small amount of time (near the end of the market closing) can be problematic in terms of price impact for large traders. There may even be behavioral factors constraining traders from exploiting this effect, such as a fear of "catching a falling knife". Institutional risk limits may also play a role by constraining the ability of traders to take directional positions.

It should be noted that these results indicate that daily mean reversion (as captured by the IBS effect) and medium-term mean reversion (as captured by the RSI strategy) are different phenomena which only partially overlap. The IBS filter can be used with similar results when combined with other mean reversion indicators, on longer timescales, with chart patterns, as well as with volatility-, breadth-, or seasonality-based trading strategies.

Conclusion

The results show that the IBS technical indicator is a strong and consistent predictor of close-to-close returns for equity ETFs trading in the U.S. Equity ETFs tend to mean revert on daily timescales; when the closing price is in the top of the day's range, close-to-close returns are lower, and vice versa. These results are generally not present in overseas markets, however.

The IBS effect is stronger during times of high volatility, after days with a large range, after days with high volume (for U.S. ETFs), during bear markets, and on Mondays. Additionally, it can not be explained by currency fluctuations. If one were to look for an explanation, the effect might be described in terms of intraday over-reaction which then reverts during the next day.

On average, a simple trading strategy exploiting the IBS effect has delivered an annual returns of over 30%, before trading costs, over the last 19 years. The requirement of frequent trading would have eroded a large part of those returns, but the IBS effect can be used in combination with other trading strategies to enhance returns (and decrease the number of trades) beyond the point where commissions and slippage (for small orders) would have a significantly deleterious effect.

Further research into the IBS effect may be focused on the index constituents, or other asset classes.

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Tables

Table 1: ETF Ticker Symbols, Geographical Area, and Fund Names

Ticker	Country / Area	Fund Name
ECH	Chile	iShares MSCI Chile Investable Market Index Fund
EEM	Emerging Markets	iShares MSCI Emerging Markets Index Fund
EFA	EAFE	iShares MSCI EAFE Index Fund
EPHE	Philippines	iShares MSCI Philippines Investable Market Index Fund
EPI	India	WisdomTree India Earnings Fund
EPP	Pacific ex-Japan	iShares MSCI Pacific ex-Japan Index Fund
EWA	Australia	iShares MSCI Australia Index Fund
EWC	Canada	iShares MSCI Canada Index Fund
EWD	Sweden	iShares MSCI Sweden Index Fund
EWG	Germany	iShares MSCI Germany Index Fund
EWH	Hong Kong	iShares MSCI Hong Kong Index Fund
EWI	Italy	iShares MSCI Italy Index Fund
EWJ	Japan	iShares MSCI Japan Index Fund
EWL	Switzerland	iShares MSCI Switzerland Index Fund
EWM	Malaysia	iShares MSCI Malaysia Index Fund
EWO	Austria	iShares MSCI Austria Index Fund
EWP	Spain	iShares MSCI Spain Index Fund
EWQ	France	iShares MSCI France Index Fund
EWS	Singapore	iShares MSCI Singapore Index Fund
EWT	Taiwan	iShares MSCI Taiwan Index Fund
EWU	U.K.	iShares MSCI United Kingdom Index Fund
EWY	South Korea	iShares MSCI South Korea Index Fund
EWZ	Brazil	iShares MSCI Brazil Index Fund
EZA	South Africa	iShares MSCI South Africa Index Fund
FXI	China	iShares FTSE China 25 Index Fund
GXG	Colombia	Global X FTSE Colombia 20 ETF
IDX	Indonesia	Market Vectors® Indonesia Index ETF
ILF	Latin America	iShares S&P Latin America 40 Index Fund
IWM	U.S.	iShares Russell 2000 Index Fund
QQQ	U.S.	Powershares QQQ
RSX	Russia	Market Vectors® Russia ETF
SPY	U.S.	SPDR S&P 500 ETF
THD	Thailand	iShares MSCI Thailand Index Fund

Table 2: Descriptive Statistics of Daily Returns

Ticker	Mean	St. Dev.	Skewness	Min.	Max.	% Days Up	Obs.	Beginning	End
ECH	0.020%	1.851%	-0.03	-12.057%	15.704%	51.68%	1521	20/11/2007	5/12/2013
EEM	0.075%	2.094%	0.68	-16.148%	22.780%	53.36%	2680	15/4/2003	5/12/2013
EFA	0.034%	1.520%	0.23	-11.157%	15.903%	52.96%	3087	27/8/2001	5/12/2013
EPHE	0.046%	1.515%	-0.23	-8.029%	7.198%	51.62%	802	29/9/2010	5/12/2013
EPI	0.002%	2.413%	0.69	-11.199%	23.438%	49.52%	1456	26/2/2008	5/12/2013
EPP	0.061%	1.688%	0.24	-11.220%	16.582%	52.26%	3048	26/10/2001	5/12/2013
EWA	0.051%	1.806%	0.13	-12.407%	20.721%	48.87%	4451	1/4/1996	5/12/2013
EWC	0.047%	1.530%	-0.30	-10.991%	12.412%	49.45%	4451	1/4/1996	5/12/2013
EWD	0.059%	2.135%	0.03	-13.648%	13.302%	49.34%	4451	1/4/1996	5/12/2013
EWG	0.041%	1.772%	0.20	-11.251%	19.766%	50.39%	4451	1/4/1996	5/12/2013
EWH	0.040%	1.999%	0.59	-12.338%	20.216%	48.08%	4451	1/4/1996	5/12/2013
EWI	0.035%	1.833%	0.02	-10.591%	15.281%	50.10%	4451	1/4/1996	5/12/2013
EWJ	0.011%	1.614%	0.48	-10.405%	15.846%	47.34%	4451	1/4/1996	5/12/2013
EWL	0.038%	1.491%	-0.09	-8.255%	11.795%	48.64%	4451	1/4/1996	5/12/2013
EWM	0.036%	2.077%	0.84	-12.500%	19.031%	45.72%	4451	1/4/1996	5/12/2013
EWO	0.038%	1.791%	-0.22	-12.644%	16.423%	47.09%	4451	1/4/1996	5/12/2013
EWP	0.051%	1.842%	0.08	-11.072%	14.540%	49.76%	4451	1/4/1996	5/12/2013
EWQ	0.040%	1.715%	0.02	-10.909%	13.039%	49.81%	4451	1/4/1996	5/12/2013
EWS	0.031%	2.014%	0.42	-11.518%	17.886%	47.49%	4451	1/4/1996	5/12/2013
EWT	0.021%	2.115%	0.14	-11.645%	14.182%	49.10%	3383	23/6/2000	5/12/2013
EWU	0.034%	1.565%	0.08	-11.976%	17.094%	49.14%	4451	1/4/1996	5/12/2013
EWY	0.065%	2.413%	0.47	-16.496%	22.429%	52.08%	3412	12/5/2000	5/12/2013
EWZ	0.068%	2.512%	0.03	-19.626%	25.608%	51.05%	3369	14/7/2000	5/12/2013
EZA	0.080%	2.279%	0.11	-20.091%	22.950%	53.64%	2651	28/5/2003	5/12/2013
FXI	0.071%	2.455%	0.58	-14.844%	20.276%	51.95%	2304	12/10/2004	5/12/2013
GXG	0.089%	1.416%	-0.06	-6.266%	7.404%	50.21%	1215	9/2/2009	5/12/2013
IDX	0.108%	2.124%	0.23	-10.321%	10.663%	50.69%	1229	20/1/2009	5/12/2013
ILF	0.079%	2.137%	0.28	-19.454%	26.245%	52.54%	3047	26/10/2001	5/12/2013
IWM	0.044%	1.611%	-0.13	-11.233%	8.634%	52.94%	3402	26/5/2000	5/12/2013
QQQ	0.034%	1.948%	0.35	-8.964%	16.843%	53.07%	3710	10/3/1999	5/12/2013
RSX	0.033%	3.159%	0.10	-22.362%	23.002%	50.87%	1659	7/5/2007	5/12/2013
SPY	0.041%	1.220%	0.12	-9.848%	14.509%	53.45%	5252	29/1/1993	5/12/2013
THD	0.057%	2.179%	0.00	-11.640%	15.477%	53.91%	1432	1/4/2008	5/12/2013
Average	0.048%	1.934%	0.18	-12.518%	16.884%	50.55%	3363	-	-

Table 3: Close-to-Close returns by IBS Bucket

Average close-to-close returns by IBS bucket and ETF. Bold values indicate that the returns for that bucket are significantly higher (1st and 2nd buckets), or lower (4th and 5th buckets) from the average day at the 1% level. Bold values in the final column indicate that the difference between the 1st and 5th buckets is statistically significantly different from zero at the 1% level.

Ticker	Buckets					1st-5th
	1st	2nd	3rd	4th	5th	
ECH	0.180%	-0.316%	-0.147%	0.027%	0.182%	-0.002%
EEM	0.436%	0.102%	-0.013%	-0.139%	-0.018%	0.454%
EFA	0.276%	0.091%	-0.045%	0.032%	-0.101%	0.377%
EPHE	0.315%	0.215%	-0.256%	0.047%	-0.038%	0.354%
EPI	0.394%	0.287%	-0.089%	-0.145%	-0.297%	0.691%
EPP	0.255%	0.173%	0.089%	-0.043%	-0.071%	0.326%
EWA	0.515%	0.149%	0.087%	0.029%	-0.290%	0.805%
EWC	0.203%	0.000%	0.118%	-0.033%	-0.055%	0.258%
EWD	0.384%	-0.026%	0.086%	0.003%	-0.164%	0.549%
EWG	0.306%	0.018%	0.067%	0.009%	-0.116%	0.422%
EWH	0.527%	0.205%	0.009%	-0.078%	-0.341%	0.868%
EWI	0.347%	0.099%	0.101%	-0.022%	-0.229%	0.576%
EWJ	0.460%	0.057%	0.101%	-0.082%	-0.300%	0.760%
EWL	0.492%	0.228%	0.083%	-0.157%	-0.254%	0.746%
EWM	0.317%	0.237%	0.169%	-0.098%	-0.303%	0.621%
EWO	0.332%	0.170%	0.235%	-0.150%	-0.181%	0.513%
EWP	0.347%	0.190%	0.033%	-0.001%	-0.198%	0.546%
EWQ	0.273%	0.100%	0.037%	-0.064%	-0.110%	0.383%
EWS	0.528%	0.324%	-0.088%	-0.098%	-0.366%	0.894%
EWT	0.482%	0.220%	-0.061%	0.014%	-0.354%	0.835%
EWU	0.349%	0.171%	0.098%	-0.047%	-0.215%	0.563%
EWY	0.456%	0.111%	0.151%	-0.089%	-0.201%	0.657%
EWZ	0.148%	0.026%	-0.070%	0.183%	0.049%	0.100%
EZA	0.498%	0.052%	0.116%	-0.119%	-0.081%	0.580%
FXI	0.580%	0.179%	0.026%	-0.129%	-0.155%	0.735%
GXG	0.078%	0.084%	0.055%	0.000%	0.133%	-0.055%
IDX	0.286%	0.039%	0.022%	0.045%	0.111%	0.175%
ILF	0.157%	-0.148%	-0.025%	0.093%	0.173%	-0.016%
IWM	0.253%	0.023%	-0.028%	-0.061%	-0.004%	0.256%
QQQ	0.254%	0.112%	0.039%	-0.123%	-0.076%	0.330%
RSX	0.415%	-0.031%	-0.227%	0.271%	-0.176%	0.591%
SPY	0.177%	-0.003%	0.050%	0.024%	-0.022%	0.199%
THD	0.526%	0.033%	0.090%	-0.153%	-0.101%	0.627%
Average	0.350%	0.096%	0.025%	-0.032%	-0.126%	0.476%

Table 4: Next-Day Probability of an Up Day by IBS bucket

Bold values indicate that the difference between the top and bottom buckets is statistically significantly greater than 0 at the 1% confidence level.

Ticker	Buckets					1st-5th
	1st	2nd	3rd	4th	5th	
ECH	49.86%	45.08%	45.34%	52.79%	59.86%	-10.00%
EEM	60.10%	53.75%	53.67%	49.50%	50.55%	9.55%
EFA	57.59%	56.00%	50.31%	53.15%	49.73%	7.85%
EPHE	60.27%	55.81%	43.09%	52.91%	47.41%	12.86%
EPI	57.14%	52.49%	49.01%	49.25%	42.89%	14.25%
EPP	56.48%	54.18%	54.48%	52.88%	47.57%	8.90%
EWA	59.23%	53.76%	53.07%	50.37%	39.39%	19.84%
EWC	54.05%	53.04%	52.73%	49.09%	46.22%	7.83%
EWD	54.43%	52.48%	51.11%	51.39%	44.58%	9.85%
EWG	55.65%	53.28%	50.45%	51.82%	45.59%	10.06%
EWH	57.38%	54.69%	48.56%	47.29%	37.16%	20.22%
EWI	56.66%	52.85%	53.63%	49.61%	43.12%	13.54%
EWJ	59.50%	49.32%	48.37%	47.59%	37.63%	21.87%
EWL	61.08%	57.20%	49.91%	48.05%	38.84%	22.24%
EWM	53.23%	52.82%	48.02%	44.04%	35.95%	17.28%
EWO	55.28%	54.51%	58.12%	49.17%	43.28%	12.00%
EWP	56.30%	55.73%	51.89%	48.59%	45.23%	11.07%
EWQ	55.77%	52.19%	51.10%	50.39%	44.19%	11.57%
EWS	58.59%	54.56%	47.06%	44.29%	37.16%	21.44%
EWT	57.80%	52.41%	51.24%	47.18%	41.81%	15.99%
EWU	57.25%	56.25%	50.50%	49.17%	41.44%	15.81%
EWY	57.36%	52.58%	54.74%	50.70%	47.26%	10.09%
EWZ	52.45%	50.47%	49.24%	52.12%	52.49%	-0.04%
EZA	60.52%	51.60%	55.65%	49.04%	51.73%	8.78%
FXI	58.16%	53.20%	50.51%	50.50%	48.92%	9.23%
GXG	49.82%	45.60%	53.07%	52.50%	50.75%	-0.93%
IDX	56.30%	48.92%	50.25%	48.84%	49.04%	7.26%
ILF	52.38%	48.77%	49.86%	53.71%	56.37%	-3.99%
IWM	54.62%	54.69%	53.44%	50.42%	52.05%	2.57%
QQQ	56.62%	54.48%	54.50%	48.55%	51.68%	4.93%
RSX	58.81%	52.26%	48.41%	52.98%	45.00%	13.81%
SPY	58.18%	54.17%	53.65%	52.10%	50.47%	7.71%
THD	64.39%	51.43%	59.21%	47.28%	50.00%	14.39%
Average	56.76%	52.74%	51.34%	49.92%	46.22%	10.54%

Table 5: Returns to Long/Short IBS Strategy by Year

Ticker	Year																			Average		
	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11		'12	'13
ECH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-8.27%	38.02%	-11.06%	-11.77%	4.71%	-4.95%	-21.26%	-2.08%
EEM	-	-	-	-	-	-	-	-	-	-	-14.88%	11.21%	5.83%	18.87%	24.76%	110.71%	29.20%	28.75%	43.17%	-2.74%	11.52%	24.22%
EFA	-	-	-	-	-	-	-	-	-6.77%	19.22%	13.68%	27.84%	5.61%	6.08%	7.05%	47.49%	36.42%	40.10%	44.53%	3.75%	7.28%	19.41%
EPHE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.29%	50.74%	8.68%	-23.67%	14.01%
EPI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110.38%	93.94%	28.72%	36.39%	-31.28%	-9.74%	38.07%
EPP	-	-	-	-	-	-	-	-	3.26%	31.11%	14.12%	20.00%	-1.42%	3.17%	31.78%	54.42%	25.29%	21.81%	13.75%	-0.04%	10.86%	17.55%
EWA	-	-	-	54.18%	68.29%	98.08%	128.40%	148.03%	73.53%	110.39%	20.58%	2.70%	1.11%	4.56%	37.09%	52.56%	59.12%	31.98%	24.92%	3.84%	8.46%	51.55%
EWC	-	-	-	23.14%	40.88%	1.98%	68.61%	-18.28%	63.00%	97.81%	35.57%	17.43%	-20.07%	8.48%	16.97%	-8.15%	-5.45%	8.99%	-14.87%	-16.72%	8.96%	17.13%
EWD	-	-	-	23.52%	38.51%	81.96%	59.53%	69.80%	40.63%	72.65%	42.22%	22.12%	21.56%	11.08%	36.70%	72.99%	11.24%	59.61%	55.19%	-3.24%	-14.11%	39.00%
EWG	-	-	-	18.11%	51.92%	44.01%	46.70%	-6.13%	26.91%	22.62%	39.51%	33.96%	13.89%	1.35%	18.98%	38.13%	48.57%	35.60%	18.43%	-12.83%	4.08%	24.66%
EWH	-	-	-	24.17%	74.42%	15.46%	58.53%	37.70%	86.08%	56.69%	53.05%	34.85%	33.03%	36.99%	51.24%	177.72%	46.71%	26.39%	19.37%	-13.48%	15.61%	46.36%
EWI	-	-	-	22.57%	3.32%	-3.02%	40.79%	62.82%	58.93%	78.38%	26.92%	33.71%	10.23%	28.41%	56.40%	79.42%	63.09%	52.15%	55.11%	31.73%	23.68%	40.26%
EWJ	-	-	-	26.85%	70.22%	23.30%	44.61%	56.02%	58.43%	82.94%	24.69%	19.09%	23.98%	27.12%	17.90%	98.57%	47.57%	22.55%	51.47%	12.95%	25.84%	40.78%
EWL	-	-	-	15.86%	56.89%	107.37%	112.50%	87.70%	60.55%	72.04%	78.00%	35.98%	14.90%	14.26%	31.40%	27.38%	60.84%	56.56%	23.13%	3.34%	-12.41%	47.02%
EWM	-	-	-	32.85%	63.80%	130.29%	3.24%	20.77%	65.95%	48.75%	31.74%	29.15%	23.90%	17.60%	44.54%	112.25%	47.73%	-4.10%	34.62%	10.26%	8.29%	40.09%
EWO	-	-	-	7.75%	5.66%	45.26%	85.64%	57.56%	51.89%	94.58%	56.43%	6.53%	8.84%	1.52%	33.27%	2.87%	15.58%	36.86%	14.09%	21.51%	0.78%	30.37%
EWP	-	-	-	20.73%	32.83%	23.80%	124.31%	45.29%	39.33%	83.15%	56.86%	9.42%	12.05%	-7.54%	20.64%	71.17%	26.70%	55.41%	44.69%	31.29%	1.90%	38.45%
EWQ	-	-	-	15.46%	34.22%	18.39%	53.68%	-1.28%	47.81%	2.27%	6.08%	34.20%	26.02%	17.26%	23.04%	54.09%	36.16%	41.92%	39.64%	10.68%	-4.26%	25.30%
EWS	-	-	-	32.78%	138.76%	91.08%	49.76%	46.79%	75.90%	128.31%	94.46%	37.42%	19.90%	10.28%	33.89%	100.05%	39.95%	-2.08%	12.67%	-10.58%	11.68%	50.61%
EWT	-	-	-	-	-	-	-	17.14%	61.13%	63.98%	84.17%	73.98%	14.42%	41.04%	48.16%	81.58%	43.63%	3.16%	31.40%	12.77%	26.74%	43.09%
EWU	-	-	-	43.81%	58.91%	67.50%	61.33%	72.60%	38.59%	35.49%	32.85%	27.60%	21.59%	19.42%	24.44%	35.25%	28.27%	25.21%	16.72%	7.28%	-3.06%	34.10%
EWY	-	-	-	-	-	-	-	63.90%	91.91%	75.47%	48.85%	25.47%	11.44%	16.38%	28.40%	62.66%	10.58%	21.88%	43.10%	-9.39%	18.51%	36.37%
EWZ	-	-	-	-	-	-	-	-6.34%	6.57%	39.96%	-22.67%	-24.52%	-31.71%	-7.90%	17.04%	53.20%	23.51%	-4.48%	5.26%	1.17%	-4.95%	3.15%
EZA	-	-	-	-	-	-	-	-	-	-	-7.40%	-24.24%	-4.03%	24.69%	57.40%	144.08%	21.11%	62.79%	48.96%	-0.66%	27.03%	31.79%
FXI	-	-	-	-	-	-	-	-	-	-	2.63%	-	-6.54%	-8.89%	45.38%	209.97%	30.73%	35.45%	32.48%	-3.20%	-0.78%	33.72%
GXG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.80%	15.39%	-8.67%	-16.06%	-16.02%	-1.11%
IDX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.45%	29.63%	10.76%	-20.72%	-13.01%	6.42%
ILF	-	-	-	-	-	-	-	-	10.25%	-24.15%	-43.50%	-42.42%	-31.08%	-2.04%	-0.97%	43.06%	4.36%	9.91%	7.68%	-9.56%	0.50%	-6.00%
IWM	-	-	-	-	-	-	-	16.97%	-3.64%	42.07%	-10.38%	5.65%	-17.65%	9.15%	28.49%	63.27%	18.26%	17.70%	31.68%	-15.49%	3.62%	13.55%
QQQ	-	-	-	-	-	-	6.03%	54.38%	32.77%	31.70%	38.60%	20.37%	-2.21%	-7.00%	7.14%	45.70%	13.30%	23.36%	17.64%	-9.08%	3.15%	18.39%
RSX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24.12%	108.56%	14.66%	8.79%	28.44%	8.47%	26.03%	31.30%
SPY	6.45%	-0.46%	-4.46%	2.36%	12.12%	22.69%	-7.78%	16.75%	5.94%	12.83%	9.61%	9.40%	8.96%	2.56%	19.94%	69.86%	19.23%	10.79%	7.50%	-10.35%	6.95%	10.52%
THD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55.99%	72.83%	22.19%	44.32%	0.91%	-4.27%	31.99%
Average	6.45%	-0.46%	-4.46%	24.28%	50.05%	51.21%	58.49%	42.11%	43.00%	55.58%	28.37%	17.29%	6.25%	11.04%	27.75%	73.77%	31.79%	25.20%	26.94%	-0.66%	3.76%	29.38%

Table 6: Volatility-Sorted, Volatility-Adjusted Close-to-Close Returns By IBS bucket

High volatility days are days when the 10-day realized volatility is above the sample median, and vice versa. Returns are adjusted by the 10-day realized volatility. Bold values indicate that the returns of that bucket are statistically significantly greater (bottom bucket), or smaller (top bucket) than the average daily return, at the 1% confidence level. Bold values in the 1st - 5th columns indicate that the returns in the bottom and top buckets have significantly different means at the 1% level.

Ticker	High Volatility			Low Volatility		
	1st	5th	1st-5th	1st	5th	1st-5th
ECH	0.115	0.108	0.007	-0.120	0.131	-0.251
EEM	0.214	-0.036	0.250	0.157	0.156	0.001
EFA	0.157	-0.077	0.234	0.174	-0.008	0.182
EPHE	0.313	-0.095	0.407	0.070	0.041	0.029
EPI	0.117	-0.159	0.275	0.076	-0.038	0.114
EPP	0.168	-0.053	0.221	0.113	0.021	0.092
EWA	0.324	-0.255	0.579	0.228	-0.065	0.292
EWC	0.120	-0.042	0.162	0.217	0.008	0.209
EWD	0.175	-0.129	0.304	0.169	0.024	0.145
EWG	0.174	-0.086	0.260	0.214	-0.020	0.233
EWH	0.229	-0.240	0.468	0.300	-0.119	0.419
EWI	0.188	-0.169	0.357	0.206	-0.073	0.279
EWJ	0.303	-0.274	0.577	0.207	-0.079	0.286
EWL	0.347	-0.251	0.598	0.273	-0.064	0.337
EWM	0.193	-0.217	0.410	0.201	-0.124	0.325
EWO	0.189	-0.159	0.348	0.217	0.019	0.198
EWP	0.157	-0.168	0.325	0.257	-0.017	0.274
EWQ	0.138	-0.104	0.241	0.228	-0.029	0.257
EWS	0.284	-0.236	0.520	0.197	-0.102	0.298
EWT	0.220	-0.212	0.433	0.234	-0.077	0.311
EWU	0.223	-0.186	0.409	0.249	-0.054	0.303
EWY	0.196	-0.149	0.346	0.202	0.044	0.159
EWZ	0.078	0.024	0.053	0.029	0.119	-0.090
EZA	0.240	-0.111	0.351	0.134	0.187	-0.053
FXI	0.215	-0.093	0.308	0.158	0.104	0.054
GXG	0.168	0.076	0.092	-0.162	0.205	-0.367
IDX	0.113	0.019	0.094	0.122	0.056	0.066
ILF	0.020	0.104	-0.084	0.085	0.216	-0.132
IWM	0.128	-0.049	0.177	0.035	0.103	-0.068
QQQ	0.151	-0.064	0.215	0.080	0.074	0.007
RSX	0.088	-0.088	0.176	0.213	0.030	0.183
SPY	0.141	-0.055	0.196	0.145	0.099	0.046
THD	0.260	-0.106	0.366	0.199	0.146	0.054
Average	0.188	-0.088	0.276	0.184	0.006	0.178

Table 7: Range-Sorted Close-to-Close Returns By IBS bucket

High range days are days whose range was higher than the 500-day median range, and vice versa. Bold values indicate that the returns of that bucket are statistically significantly greater (bottom bucket), or smaller (top bucket) than the average daily return, at the 1% confidence level. Bold values in the 1st - 5th columns indicate that the returns in the bottom and top buckets are significantly different at the 1% level.

Ticker	High Range			Low Range		
	1st	5th	1st-5th	1st	5th	1st-5th
ECH	-0.007%	0.080%	-0.087%	0.485%	0.241%	0.244%
EEM	0.322%	-0.085%	0.407%	0.621%	0.040%	0.581%
EFA	0.310%	-0.165%	0.475%	0.247%	-0.057%	0.304%
EPHE	0.279%	0.003%	0.277%	0.427%	-0.104%	0.531%
EPI	0.596%	-0.363%	0.959%	0.264%	-0.258%	0.523%
EPP	0.284%	-0.058%	0.342%	0.191%	-0.096%	0.287%
EWA	0.557%	-0.429%	0.985%	0.452%	-0.138%	0.590%
EWC	0.182%	-0.076%	0.259%	0.240%	-0.023%	0.263%
EWD	0.429%	-0.186%	0.615%	0.306%	-0.136%	0.443%
EWG	0.326%	-0.146%	0.472%	0.275%	-0.077%	0.352%
EWH	0.694%	-0.432%	1.127%	0.333%	-0.256%	0.589%
EWI	0.458%	-0.253%	0.712%	0.189%	-0.217%	0.406%
EWJ	0.485%	-0.454%	0.940%	0.431%	-0.184%	0.615%
EWL	0.530%	-0.318%	0.848%	0.437%	-0.179%	0.616%
EWM	0.485%	-0.419%	0.904%	0.195%	-0.219%	0.414%
EWO	0.354%	-0.268%	0.622%	0.280%	-0.032%	0.312%
EWP	0.417%	-0.179%	0.596%	0.236%	-0.227%	0.462%
EWQ	0.351%	-0.107%	0.459%	0.150%	-0.114%	0.264%
EWS	0.664%	-0.543%	1.208%	0.430%	-0.238%	0.668%
EWT	0.445%	-0.533%	0.978%	0.519%	-0.166%	0.684%
EWU	0.482%	-0.319%	0.801%	0.159%	-0.109%	0.268%
EWY	0.490%	-0.241%	0.730%	0.343%	-0.162%	0.505%
EWZ	0.149%	0.004%	0.145%	0.141%	0.129%	0.012%
EZA	0.558%	-0.121%	0.680%	0.367%	-0.020%	0.387%
FXI	0.599%	-0.098%	0.698%	0.574%	-0.223%	0.796%
GXG	0.108%	0.149%	-0.040%	0.041%	0.147%	-0.107%
IDX	0.525%	0.170%	0.355%	-0.052%	0.086%	-0.138%
ILF	0.149%	0.171%	-0.022%	0.166%	0.169%	-0.003%
IWM	0.366%	-0.059%	0.425%	0.036%	0.056%	-0.021%
QQQ	0.337%	-0.120%	0.457%	0.150%	-0.043%	0.192%
RSX	0.696%	-0.490%	1.186%	0.112%	0.049%	0.064%
SPY	0.201%	-0.019%	0.220%	0.128%	-0.032%	0.159%
THD	0.420%	-0.267%	0.687%	0.801%	0.088%	0.713%
Average	0.401%	-0.187%	0.588%	0.293%	-0.070%	0.363%

Table 8: Range-Sorted, Volatility-Adjusted Close-to-Close Returns By IBS bucket

High range days are days whose range was higher than the 500-day median range, and vice versa. Returns are adjusted by the 10-day realized volatility. Bold values indicate that the returns of that bucket are statistically significantly greater (bottom bucket), or smaller (top bucket) than the average daily return, at the 1% confidence level. Bold values in the 1st - 5th columns indicate that the returns in the bottom and top buckets are significantly different at the 1% level.

Ticker	High Range			Low Range		
	1st	5th	1st-5th	1st	5th	1st-5th
ECH	-0.095	0.080	-0.175	0.214	0.120	0.094
EEM	0.139	0.004	0.135	0.278	0.096	0.182
EFA	0.163	-0.077	0.240	0.219	-0.058	0.277
EPHE	0.196	-0.032	0.229	0.245	-0.082	0.327
EPI	0.256	-0.089	0.344	0.024	-0.109	0.133
EPP	0.169	-0.029	0.198	0.105	-0.046	0.151
EWA	0.306	-0.268	0.574	0.311	-0.127	0.438
EWC	0.139	-0.045	0.184	0.243	-0.047	0.290
EWD	0.222	-0.070	0.292	0.162	-0.065	0.227
EWG	0.204	-0.094	0.298	0.253	-0.051	0.304
EWH	0.344	-0.212	0.556	0.257	-0.202	0.458
EWI	0.287	-0.171	0.458	0.143	-0.151	0.294
EWJ	0.284	-0.284	0.569	0.324	-0.165	0.489
EWL	0.345	-0.233	0.578	0.355	-0.148	0.503
EWM	0.282	-0.240	0.522	0.167	-0.147	0.314
EWO	0.249	-0.143	0.392	0.205	-0.039	0.244
EWP	0.251	-0.081	0.332	0.176	-0.178	0.354
EWQ	0.240	-0.072	0.312	0.120	-0.112	0.232
EWS	0.317	-0.241	0.558	0.251	-0.139	0.389
EWT	0.227	-0.245	0.472	0.289	-0.110	0.398
EWU	0.335	-0.219	0.554	0.159	-0.102	0.260
EWY	0.219	-0.094	0.313	0.180	-0.073	0.253
EWZ	0.051	0.024	0.027	0.051	0.082	-0.032
EZA	0.253	0.006	0.247	0.126	0.058	0.067
FXI	0.188	0.030	0.158	0.211	-0.056	0.267
GXG	0.055	0.089	-0.034	0.009	0.196	-0.188
IDX	0.244	-0.008	0.252	-0.020	0.075	-0.095
ILF	0.055	0.145	-0.091	-0.013	0.160	-0.173
IWM	0.187	-0.009	0.196	-0.002	0.024	-0.026
QQQ	0.168	-0.062	0.230	0.125	0.033	0.092
RSX	0.242	-0.092	0.334	0.032	0.005	0.027
SPY	0.166	0.023	0.143	0.135	-0.007	0.142
THD	0.205	-0.084	0.288	0.405	0.084	0.322
Average	0.234	-0.088	0.322	0.184	-0.040	0.225

Table 9: Bull-/Bear- Market-Sorted Close-to-Close Returns By IBS bucket

Bull market days are defined as days which, at the close, have positive or zero 200-day return (including dividends), and vice versa. Bold values indicate that the returns of that bucket are statistically significantly greater (bottom bucket), or smaller (top bucket) than the average daily return, at the 1% confidence level. Note that despite greater means during bear markets, it is more difficult to establish statistical significance due to smaller sample sizes and higher variance. Bold values in the 1st - 5th columns indicate that the returns in the bottom and top buckets are significantly different at the 1% level.

Ticker	Bear			Bull		
	1st	5th	1st-5th	1st	5th	1st-5th
ECH	0.304%	0.162%	0.142%	0.021%	0.153%	-0.132%
EEM	0.841%	-0.340%	1.181%	0.302%	0.065%	0.236%
EFA	0.428%	-0.174%	0.602%	0.169%	-0.057%	0.227%
EPHE	0.460%	-0.043%	0.503%	0.250%	-0.053%	0.304%
EPI	0.502%	-0.326%	0.828%	0.250%	-0.243%	0.494%
EPP	0.503%	-0.134%	0.637%	0.153%	-0.054%	0.207%
EWA	0.747%	-0.361%	1.108%	0.319%	-0.262%	0.580%
EWC	0.306%	-0.093%	0.400%	0.147%	-0.039%	0.187%
EWD	0.518%	-0.377%	0.894%	0.295%	-0.067%	0.362%
EWG	0.328%	-0.264%	0.591%	0.292%	-0.056%	0.347%
EWH	0.640%	-0.475%	1.114%	0.446%	-0.271%	0.717%
EWI	0.543%	-0.430%	0.972%	0.211%	-0.118%	0.329%
EWJ	0.531%	-0.426%	0.957%	0.360%	-0.178%	0.538%
EWL	0.623%	-0.322%	0.945%	0.397%	-0.218%	0.615%
EWM	0.364%	-0.628%	0.992%	0.283%	-0.169%	0.452%
EWO	0.356%	-0.319%	0.674%	0.312%	-0.100%	0.412%
EWP	0.472%	-0.340%	0.812%	0.258%	-0.130%	0.388%
EWQ	0.354%	-0.203%	0.557%	0.227%	-0.071%	0.297%
EWS	0.553%	-0.635%	1.188%	0.503%	-0.163%	0.666%
EWT	0.642%	-0.424%	1.066%	0.346%	-0.295%	0.641%
EWU	0.369%	-0.308%	0.677%	0.335%	-0.177%	0.511%
EWY	0.582%	-0.229%	0.811%	0.372%	-0.186%	0.559%
EWZ	0.140%	-0.147%	0.287%	0.153%	0.176%	-0.023%
EZA	0.744%	-0.160%	0.904%	0.378%	-0.056%	0.434%
FXI	0.901%	-0.387%	1.289%	0.418%	-0.059%	0.477%
GXG	0.017%	0.247%	-0.230%	0.103%	0.117%	-0.015%
IDX	0.069%	0.295%	-0.227%	0.402%	0.050%	0.353%
ILF	0.330%	0.055%	0.275%	0.063%	0.213%	-0.150%
IWM	0.637%	0.022%	0.615%	0.026%	-0.016%	0.042%
QQQ	0.279%	-0.198%	0.477%	0.241%	-0.034%	0.275%
RSX	0.502%	-0.307%	0.809%	0.338%	-0.081%	0.419%
SPY	0.218%	-0.126%	0.344%	0.164%	0.003%	0.162%
THD	0.709%	-0.391%	1.100%	0.408%	0.018%	0.390%
Average	0.470%	-0.236%	0.706%	0.271%	-0.071%	0.342%

Table 10: Bull-/Bear- Market-Sorted, Volatility-Adjusted Close-to-Close Returns By IBS bucket

Bull market days are defined as days which, at the close, have positive or zero 200-day return (including dividends), and vice versa. Returns are adjusted by the 10-day realized volatility. Bold values indicate that the returns of that bucket are statistically significantly greater (bottom bucket), or smaller (top bucket) than the average daily return, at the 1% confidence level. Note that despite greater means during bear markets, it is more difficult to establish statistical significance due to smaller sample sizes and higher variance. Bold values in the 1st - 5th columns indicate that the returns in the bottom and top buckets are significantly different at the 1% level.

Ticker	Bear			Bull		
	1st	5th	1st-5th	1st	5th	1st-5th
ECH	0.012	0.124	-0.112	0.003	0.116	-0.113
EEM	0.210	-0.008	0.218	0.184	0.085	0.099
EFA	0.126	-0.055	0.180	0.193	-0.034	0.227
EPHE	0.314	-0.010	0.323	0.154	-0.040	0.195
EPI	0.110	-0.062	0.172	0.111	-0.161	0.272
EPP	0.117	-0.040	0.157	0.152	-0.008	0.160
EWA	0.331	-0.175	0.506	0.246	-0.148	0.393
EWC	0.170	-0.044	0.214	0.157	-0.008	0.165
EWD	0.133	-0.167	0.300	0.199	-0.002	0.201
EWG	0.137	-0.102	0.240	0.226	-0.030	0.257
EWH	0.173	-0.178	0.351	0.322	-0.179	0.501
EWI	0.205	-0.192	0.397	0.193	-0.080	0.273
EWJ	0.257	-0.228	0.485	0.268	-0.128	0.396
EWL	0.332	-0.216	0.548	0.304	-0.132	0.436
EWM	0.146	-0.255	0.401	0.230	-0.135	0.365
EWO	0.175	-0.147	0.323	0.221	-0.028	0.249
EWP	0.196	-0.157	0.353	0.205	-0.061	0.266
EWQ	0.125	-0.110	0.235	0.211	-0.047	0.258
EWS	0.188	-0.254	0.442	0.324	-0.100	0.424
EWT	0.229	-0.129	0.357	0.227	-0.159	0.386
EWU	0.152	-0.143	0.295	0.282	-0.111	0.393
EWY	0.163	-0.077	0.240	0.222	-0.045	0.267
EWZ	0.059	-0.031	0.089	0.054	0.133	-0.079
EZA	0.166	0.087	0.079	0.212	0.037	0.175
FXI	0.181	-0.032	0.213	0.202	0.018	0.184
GXG	-0.060	0.193	-0.253	0.050	0.126	-0.076
IDX	0.004	0.088	-0.084	0.187	0.019	0.167
ILF	0.088	0.096	-0.008	0.029	0.189	-0.159
IWM	0.255	0.023	0.232	-0.001	0.030	-0.031
QQQ	0.108	-0.057	0.165	0.132	0.029	0.102
RSX	0.115	-0.042	0.157	0.170	-0.015	0.185
SPY	0.097	-0.055	0.152	0.165	0.044	0.121
THD	0.221	-0.120	0.342	0.253	0.083	0.170
Average	0.159	-0.075	0.234	0.184	-0.022	0.207

Table 11: Volume-Sorted Close-to-Close Returns By IBS bucket

The table contains average close-to-close returns separated by IBS bucket, as well as the difference between the top and bottom buckets. High volume days are days whose volume was higher than the 500-day median volume, and vice versa. Bold values indicate that the returns of that bucket are statistically significantly greater (bottom bucket), or smaller (top bucket) than zero, and statistically significantly different from zero (1st - 5th buckets) at the 1% confidence level. Bold values in the 1st - 5th columns indicate that the returns in the bottom and top buckets are significantly different at the 1% level.

Ticker	High Volume			Low Volume		
	1st	5th	1st-5th	1st	5th	1st-5th
Non-U.S. ETFs						
ECH	0.077%	0.189%	-0.111%	0.305%	0.101%	0.205%
EEM	0.467%	-0.083%	0.550%	0.319%	0.144%	0.175%
EFA	0.270%	-0.111%	0.381%	0.308%	-0.068%	0.375%
EPHE	0.274%	0.027%	0.247%	0.482%	-0.250%	0.733%
EPI	0.384%	-0.146%	0.530%	0.479%	-0.620%	1.099%
EPP	0.320%	-0.026%	0.346%	0.112%	-0.158%	0.271%
EWA	0.455%	-0.302%	0.757%	0.615%	-0.274%	0.888%
EWC	0.190%	-0.044%	0.234%	0.231%	-0.078%	0.310%
EWD	0.342%	-0.195%	0.537%	0.454%	-0.112%	0.565%
EWG	0.378%	-0.095%	0.473%	0.176%	-0.162%	0.337%
EWH	0.675%	-0.353%	1.028%	0.311%	-0.326%	0.637%
EWI	0.377%	-0.212%	0.589%	0.290%	-0.249%	0.539%
EWJ	0.504%	-0.307%	0.811%	0.359%	-0.284%	0.643%
EWL	0.470%	-0.211%	0.681%	0.530%	-0.322%	0.851%
EWM	0.316%	-0.306%	0.622%	0.316%	-0.298%	0.614%
EWO	0.258%	-0.148%	0.407%	0.432%	-0.232%	0.665%
EWP	0.306%	-0.111%	0.418%	0.401%	-0.347%	0.748%
EWQ	0.323%	-0.081%	0.404%	0.197%	-0.156%	0.354%
EWS	0.624%	-0.459%	1.083%	0.423%	-0.255%	0.678%
EWT	0.548%	-0.355%	0.903%	0.295%	-0.344%	0.638%
EWU	0.407%	-0.235%	0.642%	0.228%	-0.180%	0.408%
EWY	0.539%	-0.241%	0.780%	0.261%	-0.133%	0.394%
EWZ	0.121%	0.010%	0.111%	0.224%	0.157%	0.068%
EZA	0.555%	-0.092%	0.648%	0.368%	-0.061%	0.429%
FXI	0.799%	-0.236%	1.035%	0.094%	-0.009%	0.103%
GXG	0.026%	0.123%	-0.097%	0.211%	0.202%	0.009%
IDX	0.245%	-0.093%	0.339%	0.349%	0.471%	-0.122%
ILF	0.285%	0.152%	0.132%	0.051%	0.203%	-0.152%
RSX	0.456%	-0.249%	0.706%	0.274%	0.049%	0.225%
THD	0.515%	-0.065%	0.580%	0.572%	-0.161%	0.733%
Average	0.384%	-0.142%	0.525%	0.322%	-0.125%	0.447%
U.S. ETFs						
SPY	0.212%	-0.028%	0.240%	0.070%	-0.015%	0.085%
IWM	0.261%	-0.096%	0.357%	0.183%	0.198%	-0.015%
QQQ	0.349%	-0.179%	0.528%	0.072%	0.027%	0.045%
Average	0.274%	-0.101%	0.375%	0.108%	0.070%	0.038%

Table 12: Volume-Sorted, Volatility-Adjusted Close-to-Close Returns By IBS bucket

The table contains average volatility-adjusted close-to-close returns separated by IBS bucket, as well as the difference between the top and bottom buckets. High volume days are days whose volume was higher than the 500-day median volume, and vice versa. Returns are adjusted by the 10-day realized volatility. Bold values indicate that the returns of that bucket are statistically significantly greater (bottom bucket), or smaller (top bucket) than zero at the 1% confidence level. Bold values in the 1st - 5th columns indicate that the returns in the bottom and top buckets are significantly different at the 1% level.

Ticker	High Volume			Low Volume		
	1st	5th	1st-5th	1st	5th	1st-5th
Foreign Country ETFs						
ECH	-0.018	0.075	-0.093	0.078	0.138	-0.060
EEM	0.197	0.032	0.165	0.198	0.102	0.096
EFA	0.157	-0.043	0.200	0.275	-0.102	0.377
EPHE	0.167	-0.028	0.195	0.366	-0.155	0.521
EPI	0.154	-0.055	0.209	0.093	-0.206	0.298
EPP	0.148	-0.016	0.164	0.154	-0.068	0.222
EWA	0.254	-0.215	0.468	0.407	-0.178	0.585
EWC	0.173	-0.040	0.214	0.182	-0.060	0.242
EWD	0.194	-0.092	0.287	0.209	-0.024	0.233
EWG	0.258	-0.075	0.333	0.157	-0.085	0.242
EWH	0.345	-0.185	0.529	0.242	-0.240	0.482
EWI	0.268	-0.149	0.417	0.163	-0.165	0.328
EWJ	0.303	-0.203	0.506	0.305	-0.242	0.548
EWL	0.330	-0.155	0.485	0.392	-0.257	0.649
EWM	0.273	-0.153	0.425	0.150	-0.234	0.384
EWO	0.202	-0.094	0.297	0.284	-0.118	0.402
EWP	0.223	-0.069	0.291	0.227	-0.212	0.439
EWQ	0.238	-0.076	0.313	0.132	-0.113	0.245
EWS	0.316	-0.218	0.534	0.232	-0.137	0.369
EWT	0.274	-0.158	0.431	0.212	-0.217	0.429
EWU	0.280	-0.167	0.447	0.230	-0.150	0.380
EWY	0.227	-0.134	0.361	0.163	0.004	0.160
EWZ	0.036	0.030	0.006	0.097	0.085	0.012
EZA	0.253	0.014	0.239	0.122	0.043	0.079
FXI	0.242	-0.011	0.253	0.105	-0.009	0.113
GXG	0.007	0.137	-0.130	0.106	0.162	-0.056
IDX	0.042	-0.098	0.139	0.285	0.257	0.028
ILF	0.066	0.159	-0.093	0.004	0.162	-0.158
RSX	0.101	-0.053	0.154	0.254	0.013	0.241
THD	0.293	0.023	0.270	0.233	-0.054	0.286
Average	0.200	-0.067	0.267	0.202	-0.069	0.271
U.S. ETFs						
SPY	0.186	0.004	0.183	0.066	0.021	0.045
IWM	0.144	-0.052	0.196	0.026	0.132	-0.106
QQQ	0.194	-0.066	0.260	0.062	0.049	0.013
Average	0.175	-0.038	0.213	0.051	0.067	-0.016

Table 13: Bottom - Top Bucket Difference of Average Close-to-Close Returns by Day of the Week

This table contains the difference in average close-to-close returns between the 1st and 5th IBS buckets, grouped by day of the week.					
Ticker	Day of the Week				
	Monday	Tuesday	Wednesday	Thursday	Friday
ECH	0.238%	-0.327%	-0.087%	-0.355%	0.479%
EEM	0.971%	0.309%	0.443%	0.336%	0.246%
EFA	0.630%	0.518%	0.299%	0.183%	0.240%
EPHE	0.326%	0.262%	0.208%	0.796%	0.279%
EPI	1.203%	0.641%	0.816%	0.575%	0.159%
EPP	0.701%	0.228%	-0.011%	0.441%	0.262%
EWA	1.199%	0.697%	0.616%	0.685%	0.817%
EWC	0.542%	0.180%	0.174%	0.213%	0.201%
EWD	0.824%	0.581%	0.369%	0.678%	0.327%
EWG	0.777%	0.502%	0.296%	0.295%	0.276%
EWH	1.286%	0.843%	0.832%	0.977%	0.353%
EWI	0.818%	0.531%	0.378%	0.485%	0.667%
EWJ	1.112%	0.850%	0.516%	0.792%	0.542%
EWL	0.976%	0.795%	0.500%	0.823%	0.622%
EWM	0.503%	0.529%	0.800%	0.717%	0.508%
EWO	0.703%	0.518%	0.374%	0.381%	0.602%
EWP	0.981%	0.288%	0.454%	0.547%	0.403%
EWQ	0.746%	0.417%	0.094%	0.281%	0.395%
EWS	1.206%	0.885%	0.934%	0.912%	0.595%
EWT	1.411%	0.709%	0.664%	0.632%	0.817%
EWU	0.698%	0.775%	0.438%	0.566%	0.340%
EWY	1.344%	0.810%	0.324%	0.728%	0.076%
EWZ	0.468%	0.218%	-0.351%	0.046%	0.073%
EZA	0.772%	0.632%	0.380%	0.545%	0.521%
FXI	1.083%	0.762%	0.522%	1.001%	0.267%
GXG	0.080%	-0.605%	0.262%	0.084%	-0.090%
IDX	0.023%	-0.037%	0.282%	0.526%	0.031%
ILF	0.272%	0.068%	-0.107%	-0.078%	-0.324%
IWM	0.493%	0.277%	0.273%	0.370%	-0.127%
QQQ	0.607%	0.491%	0.394%	0.291%	-0.103%
RSX	0.558%	0.669%	1.665%	0.003%	0.016%
SPY	0.452%	0.304%	0.128%	0.105%	0.023%
THD	0.908%	0.475%	0.904%	0.627%	0.110%
Average	0.755%	0.448%	0.418%	0.461%	0.291%

Table 14: Close-to-Close Return Skewness by IBS bucket

Skewness of Close-to-Close Returns sorted by IBS bucket. Skewness values statistically significantly different from zero at the 1% level are highlighted in bold.

Ticker	Buckets					1st-5th
	1st	2nd	3rd	4th	5th	
ECH	1.302	-1.111	-0.934	-0.307	-0.482	1.784
EEM	1.954	-0.144	-0.453	1.532	-0.852	2.807
EFA	1.075	-1.073	-0.560	1.710	-0.923	1.998
EPHE	-1.014	0.504	-0.669	0.156	0.054	-1.068
EPI	1.700	0.544	0.042	-0.842	-0.161	1.862
EPP	1.249	-0.371	-0.400	-1.108	0.333	0.917
EWA	0.061	-0.229	-0.549	1.144	-0.382	0.443
EWC	-0.474	-0.939	-0.338	0.309	-0.203	-0.271
EWD	0.515	-1.018	0.237	-0.700	0.147	0.367
EWG	0.081	1.278	-0.042	0.257	-0.369	0.450
EWH	1.890	0.075	-0.285	0.197	-0.108	1.998
EWI	0.313	0.017	0.596	-0.117	-0.647	0.959
EWJ	0.695	-0.152	0.919	0.887	0.064	0.631
EWL	0.262	-0.466	-0.081	-0.140	-0.330	0.593
EWM	1.111	0.748	0.617	1.735	0.206	0.905
EWO	0.236	-0.527	-0.776	0.140	-0.794	1.030
EWP	0.257	-0.484	1.032	-0.016	-0.525	0.782
EWQ	0.473	-0.490	0.561	-0.342	-0.385	0.859
EWS	0.627	0.793	-0.093	0.714	-0.157	0.784
EWT	0.611	0.361	-0.154	0.724	-0.578	1.189
EWU	0.967	-0.593	-0.032	0.540	-0.719	1.686
EWY	0.840	0.134	1.161	-0.692	0.428	0.412
EWZ	-0.156	-0.435	-0.140	1.631	-0.942	0.786
EZA	1.617	-0.957	-0.265	0.115	-1.202	2.819
FXI	1.620	0.502	-0.296	0.725	-0.909	2.529
GXG	-0.238	0.723	-0.537	-0.212	0.029	-0.267
IDX	-0.382	0.897	0.316	0.390	0.500	-0.882
ILF	0.817	-1.455	-0.854	2.908	-0.357	1.174
IWM	0.610	-0.654	-0.944	-0.414	-0.150	0.760
QQQ	0.740	0.559	0.454	-0.010	-0.393	1.133
RSX	0.254	-1.513	0.673	0.647	0.622	-0.368
SPY	0.412	-1.148	1.704	-0.277	-0.696	1.108
THD	0.219	0.263	0.463	-0.364	-0.650	0.869
Average	0.613	-0.193	0.011	0.331	-0.319	0.933

Table 15: RSI Strategy Statistics

Average daily returns, total returns, daily return win rate, and total days spent in market for the RSI(3) strategy and the RSI(3) strategy with the IBS ≤ 0.5 filter.

Ticker	RSI(3) Only				RSI(3) w/ IBS Filter				IBS < 0.5	
	Mean	Sum	WR	Days	Mean	Sum	WR	Days	Mean	WR
ECH	-0.063%	-25.1%	49.4%	399	-0.071%	-17.7%	47.6%	250	-0.044%	47.1%
EEM	0.232%	125.2%	55.9%	540	0.394%	129.5%	60.5%	329	0.235%	56.4%
EFA	0.135%	82.1%	51.6%	607	0.208%	77.5%	52.0%	373	0.153%	55.3%
EPHE	-0.041%	-7.3%	49.2%	177	-0.010%	-1.0%	47.9%	94	0.170%	55.6%
EPI	0.009%	3.1%	51.7%	358	0.158%	31.4%	52.8%	199	0.252%	54.3%
EPP	0.271%	154.2%	57.2%	570	0.386%	127.1%	57.4%	329	0.195%	55.6%
EWA	0.293%	251.4%	55.9%	859	0.545%	250.7%	59.8%	460	0.349%	57.0%
EWC	0.065%	61.2%	50.9%	945	0.161%	83.6%	54.3%	519	0.150%	54.1%
EWD	0.280%	272.8%	53.5%	975	0.426%	207.6%	55.6%	487	0.237%	53.6%
EWG	0.111%	104.6%	51.2%	943	0.217%	113.5%	52.6%	523	0.180%	54.1%
EWH	0.132%	134.2%	48.8%	1015	0.407%	244.9%	53.3%	602	0.296%	53.9%
EWI	0.140%	135.3%	52.2%	964	0.230%	123.9%	53.3%	538	0.230%	55.0%
EWJ	0.060%	62.8%	50.3%	1041	0.260%	150.6%	55.8%	579	0.255%	53.9%
EWL	0.139%	129.0%	51.0%	931	0.340%	177.2%	55.7%	522	0.333%	57.4%
EWM	0.049%	51.8%	44.6%	1055	0.227%	132.0%	48.5%	582	0.281%	52.8%
EWO	0.061%	61.1%	46.6%	1000	0.232%	106.1%	54.3%	457	0.265%	55.4%
EWP	0.231%	212.8%	52.9%	921	0.394%	186.8%	55.3%	474	0.262%	55.3%
EWQ	0.168%	159.0%	51.1%	947	0.248%	137.7%	52.5%	556	0.198%	54.3%
EWS	0.274%	250.7%	51.8%	914	0.573%	311.6%	57.9%	544	0.359%	55.4%
EWT	0.170%	131.4%	53.0%	771	0.428%	178.3%	56.6%	417	0.310%	54.7%
EWU	0.193%	175.9%	52.5%	913	0.324%	160.5%	55.2%	495	0.235%	55.3%
EWY	0.238%	163.0%	53.3%	685	0.473%	180.1%	57.0%	381	0.259%	54.8%
EWZ	0.114%	92.2%	49.4%	807	0.154%	73.8%	51.3%	480	0.052%	50.5%
EZA	0.345%	184.0%	58.5%	533	0.336%	102.2%	57.2%	304	0.264%	56.0%
FXI	0.232%	120.7%	55.6%	520	0.448%	124.5%	56.5%	278	0.326%	55.3%
GXG	0.194%	55.3%	55.8%	285	-0.005%	-0.9%	49.4%	180	0.058%	49.1%
IDX	0.112%	29.9%	50.7%	268	0.185%	29.6%	51.9%	160	0.096%	51.7%
ILF	0.146%	100.8%	51.7%	690	0.208%	88.5%	53.2%	425	0.068%	51.5%
IWM	0.132%	95.5%	54.7%	722	0.299%	137.7%	58.6%	461	0.160%	55.5%
QQQ	0.280%	224.4%	55.4%	801	0.460%	247.8%	60.1%	539	0.159%	55.1%
RSX	0.311%	117.0%	54.8%	376	0.421%	88.7%	56.4%	211	0.097%	53.6%
SPY	0.190%	205.1%	59.1%	1081	0.297%	205.5%	62.4%	692	0.093%	55.7%
THD	0.048%	14.2%	56.5%	299	0.313%	53.5%	59.6%	171	0.286%	59.5%
Average	0.159%	119.0%	52.6%	725	0.293%	128.6%	54.9%	412	0.207%	54.4%

Figures

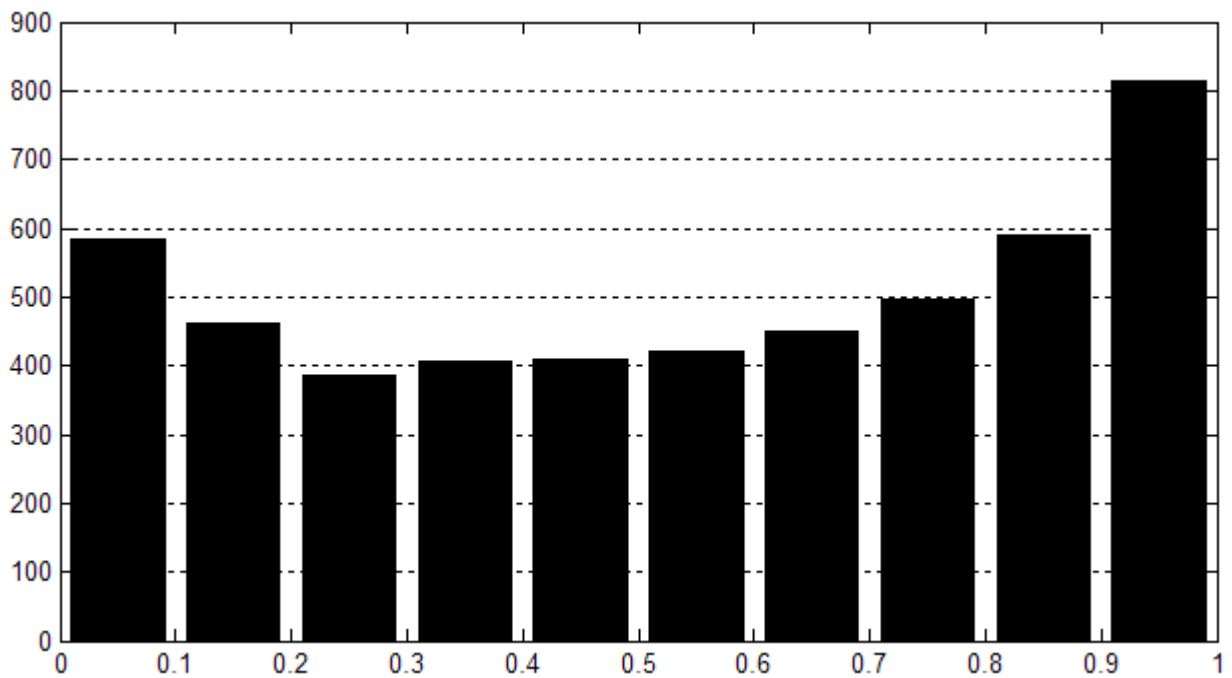


Figure 1: Histogram of IBS values for SPY.

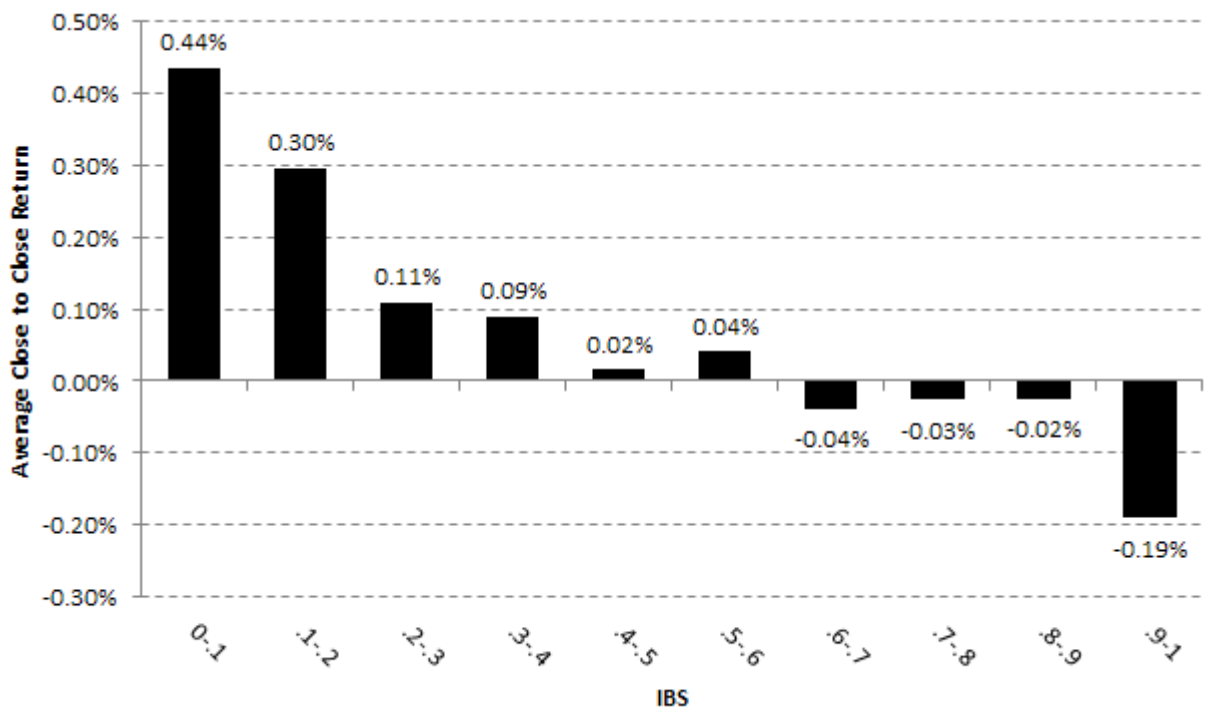


Figure 2: IBS plotted against Close-to-Close Returns, average for all ETFs.

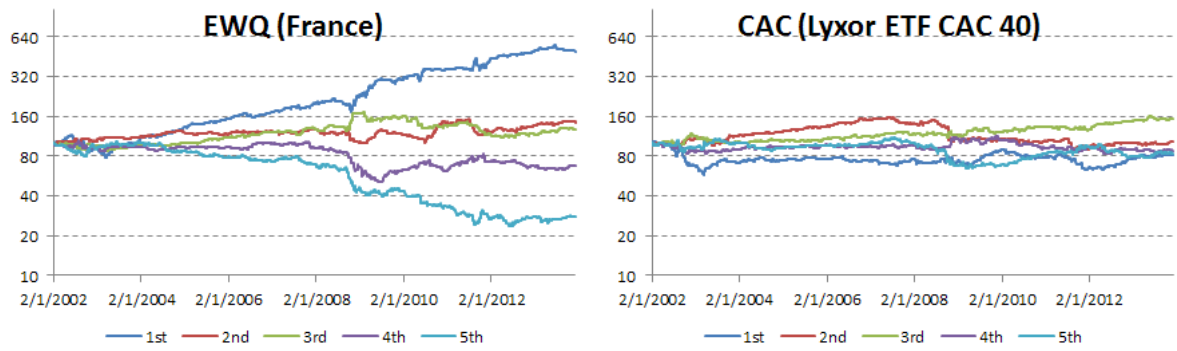


Figure 3: U.S.- and Locally-Listed France ETF Cumulative Performance by IBS Bucket

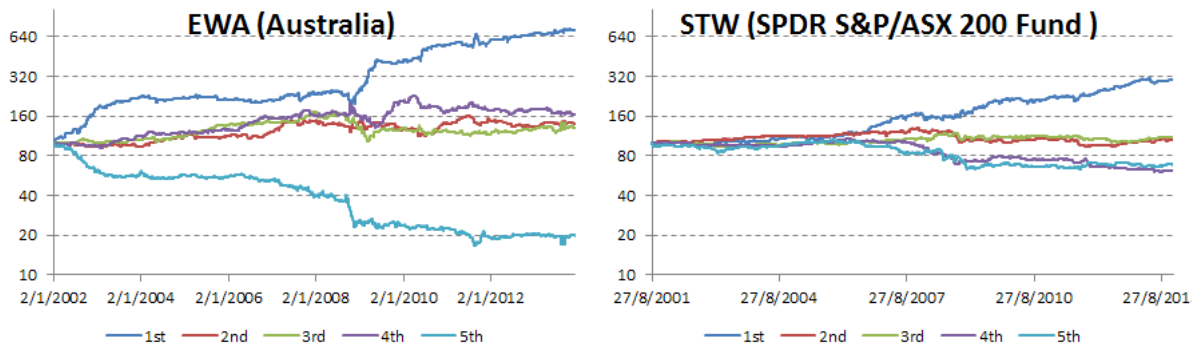


Figure 4: U.S.- and Locally-Listed Australia ETF Cumulative Performance by IBS Bucket

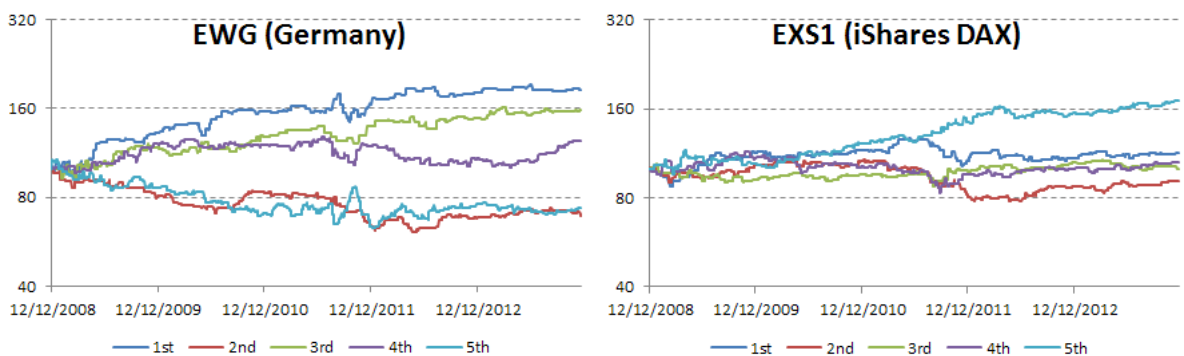


Figure 5: U.S.- and Locally-Listed Germany ETF Cumulative Performance by IBS Bucket

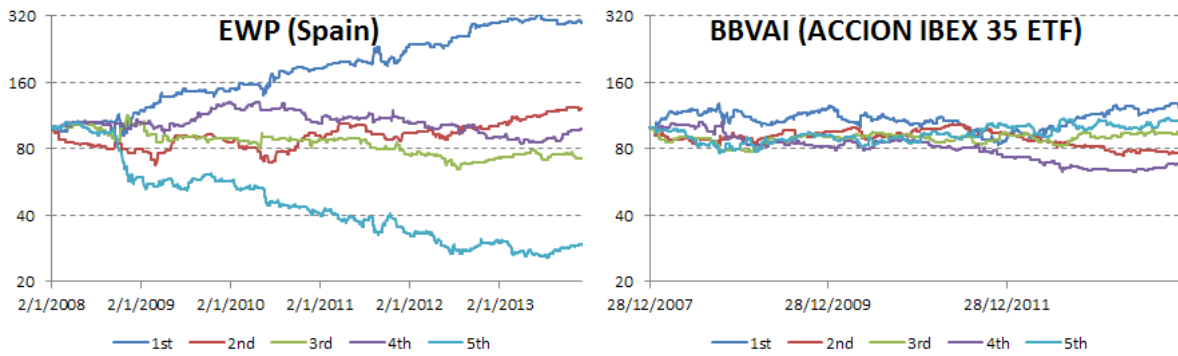


Figure 6: U.S.- and Locally-Listed Spain ETF Cumulative Performance by IBS Bucket

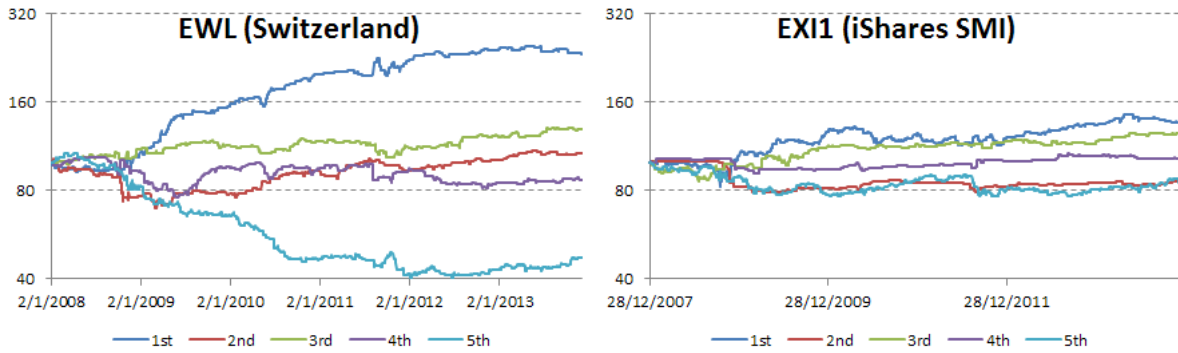


Figure 7: U.S.- and Locally-Listed Switzerland ETF Cumulative Performance by IBS Bucket

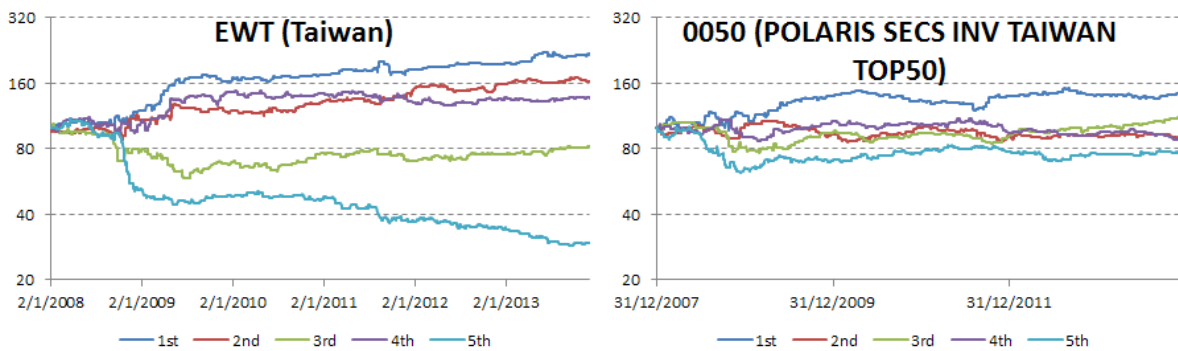


Figure 8: U.S.- and Locally-Listed Taiwan ETF Cumulative Performance by IBS Bucket

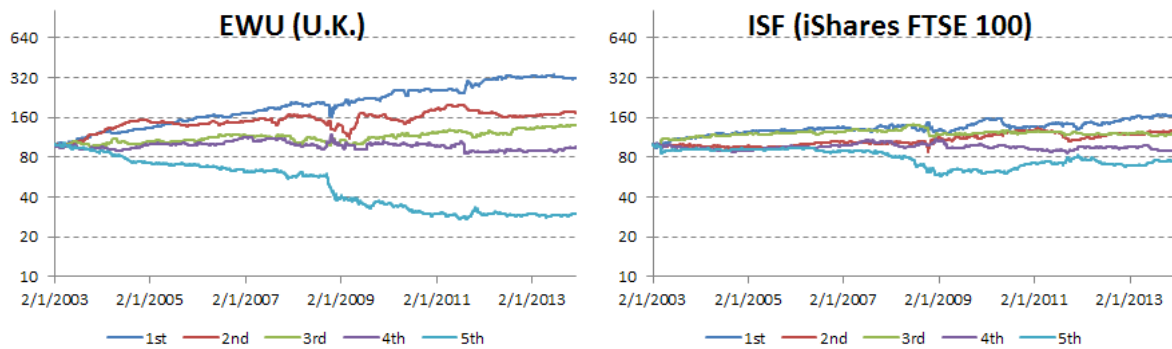


Figure 9: U.S.- and Locally-Listed U.K. ETF Cumulative Performance by IBS Bucket

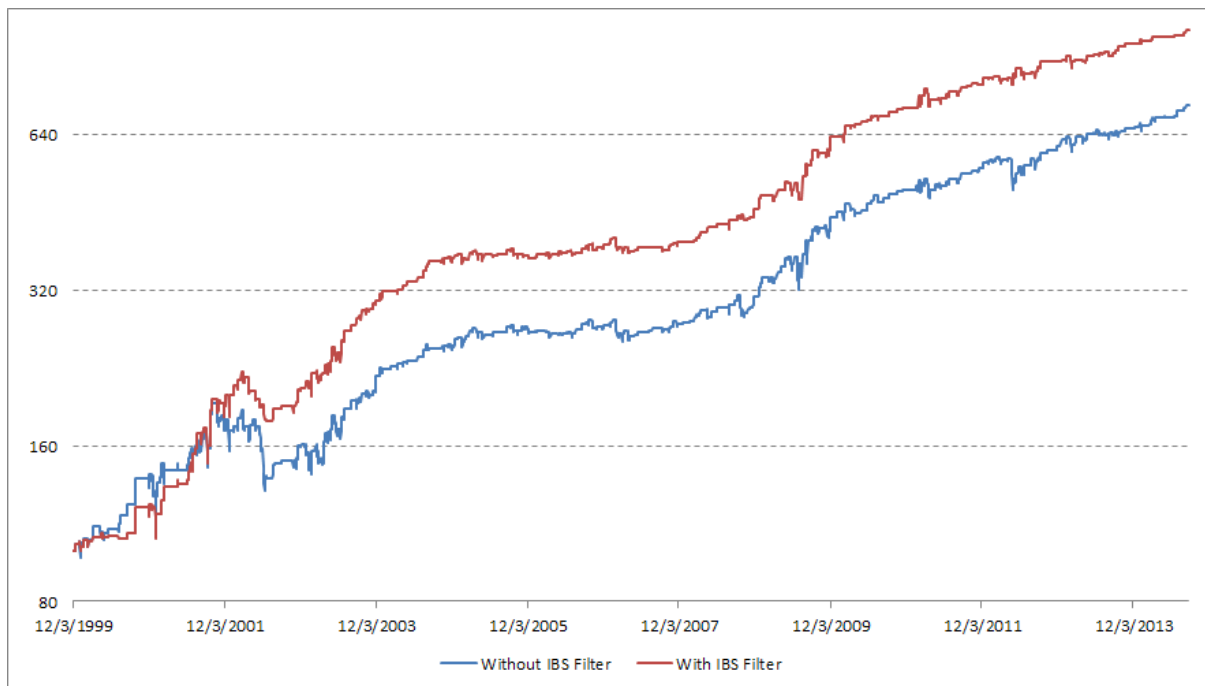


Figure 10: RSI(3) Strategy Applied to QQQ, Equity Curves