CNBC iQ100

POWERED BY M•CAM

Innovation $\alpha^{®}$ - A Quantitative Metric of Market Value

David Martin, M•CAM Founder and President
Aditya Bindra, Quantitative Analyst

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Introduction

Traditional metrics of determining the value of corporations and their associated equity and debt are heavily reliant on economic data reported under Generally Accepted Accounting Principles (GAAP). Intellectual capital and Intangible Assets in corporate America have been estimated to account for over $12 trillion while global valuation is close to $22 trillion yet does not have any meaningful or reliable reporting mechanism under GAAP. As the largest non-financial asset base in the global market place, the fact that these assets are opaque to the public investor is an artifact of accounting anachronism. Most of management's time is spent on managing tangible assets including human capital, brand, innovation, market-advantage and supply-chain dynamics.[1] Nearly two decades ago, PriceWaterhouseCoopers, LLC estimated that intangible assets represented 78% of the value of the S&P 500. In 2013, Bloomberg reported that as little as 7% of large corporations' value is captured in tangible assets with over 90% reflected in patents, brands, copyrights and other intangibles.[2] The Bureau of Economic Analysis in the U.S. and the World Trade Organization's Organization for Economic Cooperation and Development (OECD) recognize intangibles as a material component of GDP calculations.[3]

For over 120 years, investors have relied on arbitrary indices and industry classifiers to estimate market dynamics and associated market behavior. At the intersection of asset allocation investment strategies and the rise of technology-aided trading, the investment community has been challenged to differentiate individual, index, or bench-mark performance. With the proliferation of exchange traded funds (ETFs) and algorithmic trading, mean reversion performance is the sequelae of consensus data covariance.

Innovation $\alpha^{®}$ is a quantitative analysis technology to understand market dynamics heretofore inaccessible to investors. For over two decades, M·CAM has measured the global quality and market deployment of intangible assets in publicly traded and private firms. This measurement has contributed to market insights and regulatory reform ranging from accounting, to tax, to world trade econometrics. Aggregating innovation data from over 160 countries and assessing it for its uniqueness, market fitness, and its utility to create marginal price advantage, M·CAM has commercially deployed its unique unstructured data-mining technologies for banking, trading, and advisory programs internally and for third parties. It is now launching the inaugural CNBC IQ 100 Index Powered by M·CAM Innovation $\alpha^{®}$.

Background

Intellectual Property (IP) is a category of intangible rights protecting commercially valuable products of the human intellect. While IP traditionally covers trademark, copyrights and patent rights, the category also includes trade-secret rights, publicity rights, moral rights, and rights against unfair competition. Furthermore, it is recognized that non-traditional intangible rights such as water rights, pollution rights, and other forms of contractual rights may also fit within this class of assets.

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[1] http://media.wiley.com/product_data/excerpt/46/04714794/0471479446-1.pdf
[2] Coy, P. "The Rise of the Intangibles Economy: U.S. GDP Counts R&D, Artistic Creation". *Bloomberg* July 18, 2013.
[3] www.bea.gov/gdp-revisions.

While the individual components of intellectual or intangible assets are wide-ranging, patents, trademarks and copyrights have been the components most often associated with IP. These three forms of intellectual property can hold great commercial value, depending on the amount of protection afforded the property right. Although the specific level of protection varies from property to property, general protection for these properties are as follows:

> Patents – A patent from the United States government or other relevant global authorities gives an inventor the right to exclude others from making, using or selling the patented invention for up to twenty years. Inherent in this right to exclude is the commercially valuable power to control who uses the patented technology.
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> Trademarks – A trademark is a word, phrase, logo or other graphic symbol used by a manufacturer or seller to distinguish its product or products from those of others. The trademark right can exist as long as the business continues to use the mark. The protection of trademarks is the law's recognition of the psychological function of symbols. Some examples include the Nike® swoosh, the Xerox® logo, and the golden arches of McDonalds®.
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> Copyrights – A copyright protects original works of authorship, such as writings, music and works of art that have been tangibly expressed. The holder of a copyright has the exclusive right to reproduce, adapt, distribute, perform and display the work. The Library of Congress registers copyrights, which last the life of the author plus 50 years. Some examples include: Disney's Mickey Mouse character, Grant Wood's famous painting *American Gothic* and Microsoft's computer software.

The management of IP is increasingly gaining importance in the daily management of business assets. Although these assets have been largely ignored in the past, increased global economic competition is forcing companies to search for new sources of economic advantage. Successfully protecting, valuing and managing IP has become a key strategic advantage for many companies within a variety of industries.

The growing importance of IP is reflected in the steady increase in patent applications and the expanding field of patentable subject matter. The first six million patents issued by the USPTO were issued over a period of 210 years ending in 2000. It was projected that the next six million patents would be sought by the year 2015, a period of only sixteen years.[4] This estimate proved too conservative as the actual number of patents issued by 2015 was nearly 9 million.[5] Part of this growth in patent filings is fueled by the evolving protection given certain types of discoveries. For example, genetic discoveries became patentable in 1980, software inventions became patentable in 1981 and novel business methods became patentable in 1998. In 1999, the USPTO issued 154,594 patents, with IBM receiving the equivalent of ten patents per working day.[6]

Patents are increasingly being used by companies to act as competitive barriers to entry against their competition. From 1990 to 1999, copyright, trademark, and patent litigation cases increased 49.4%.[7] In essence, a patent provides a government sanctioned exclusivity, and the increasing trend in patent litigation validates the perceived value that a patent provides its holder. In addition to providing

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[4] Web Bryant, Businesses Battle over Intellectual Property, USA Today, Aug. 2, 2000 at 2B.
[5] http://www.uspto.gov/web/offices/ac/ido/oeip/taf/issuyear.htm
[6] The Corporate Patent Scorecard, Intellectual Property Today, July 2000 at 6.
[7] Web page located at http://www.uscourts.gov/ttb/apr99ttb/increase.html (Aug. 31, 2000).

competitive barriers, companies are realizing that new income streams can be generated through licensing patented technologies. Intangible asset licensing revenue was $329 billion in 2013 with nearly 1/3 of the global revenues flowing to U.S. companies.[8] Despite this rise in licensing revenues, most licensing opportunities remain largely untapped. It has been estimated that United States companies have upward of $1 trillion per year in untapped intellectual property licensing fees.[9]

Notwithstanding the considerable value options resulting from some IP, researchers and investors have long struggled to find market relationships between granted rights and market and equity price effects. In research on understanding the implications of intangibles on business valuation "information complexity" is seen as a barrier to any generalizable application of valuation frameworks.[10,11] More problematic is the well-publicized problem of the quality of IP granting regimes in which as much as 50% of issued patent rights, for example, are rejected when subject to litigated validity challenges.[12] In short, the preponderance of research on the subject of IP and market value and equity dynamics has shown that, without *a priori* assessment of the quality of the rights held by firms, the contribution of macro descriptions of IP offer little to no value in estimating equity dynamics. M·CAM has uniquely provided this insight to Congressional oversight and regulatory bodies since 2001.[13] In Congressional testimony, we reported that qualitative deficiencies were evident in over 30% of all patents issued by the United States Patent and Trademark Office (USPTO).[14]

While the dynamics surrounding misrepresented and misappropriated IP rights presents an accounting and valuation challenge, it does, in the same instance, create an exceptional mechanism to identify corporations who are seeking to develop equivalent proprietary market advantages. Both in willfully expropriated and unintended contemporaneous innovation, identifying firms that are competing for the same marginal market controls and pricing advantages allows algorithms to detect "Peer Groups" of overlapping market initiatives. When substantial overlapping innovation is detected, the identity of Peer Groups becomes evident and market dynamics within cohorts of market participants can be quantitatively measured.

Innovation α® Explained

M•CAM has measured the "creditworthiness" of Intellectual Property (IP) and Intangible Assets (IA) for nearly two decades through numerous boom and bust equity and credit cycles. This means that actual intangible assets– contracts, patents, licenses, copyrights, designs, trademarks, permits, etc. – held by firms are examined; are compared qualitatively to the equivalent rights held by other firms; and, the economic consequence of these assets on the underlying enterprise is characterized. Additionally, constant (weekly) surveillance is maintained on the innovation activities of all firms, institutions and individuals within the World Trade Organization (WTO) countries. To do this, M·CAM maintains the world's largest repository of state-granted rights from over 160 countries representing, in some instances, over 200 years of historical data. Using internationally recognized unstructured text linguistic

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8 http://www.progressive-economy.org/trade_facts/u-s-share-of-world-intellectual-property-revenue-39-percent/

9 Web Bryant, Businesses Battle over Intellectual Property, USA Today, Aug. 2, 2000 at 1B.

10 Gu, F. & Wang, W. 'Intangible assets, information complexity, and analysts earnings forecasts', *Journal of Business Finance & Accounting* 32, 1673–1702. (2005)

11 Amir, E., Lev, B. & Sougiannis, T., 'Do financial analysts get intangibles?', *European Accounting Review* 12, 635–659. (2003)

12 Allison, J. and Lemley, M. "Empirical Evidence on the Validity of Litigated Patents." *American Intellectual Property Law Association Quarterly Journal*, 26, pp. 185-269 (1998).

13 Martin, D.E. "Patents: Improving Quality and Curing Defects". Congressional Testimony for the United States House of Representatives Committee for the Judiciary. (2001).

14 *Ibid.*

genomic algorithms, the quality of these rights is measured and associated with business transactions reported in financial statements, contracts, bid proposals, trade records and other publicly available (but hard to find) data. This analysis provides an absolute qualitative and quantitative measure of each individual company's innovation and management thereof. It also provides a relative score of how one company's performance is likely to compare with others with whom it cooperates or competes. The measured difference between better and worse performers is Innovation α®. This methodology has been deployed for algorithm-based quantitative trading for several years and has consistently demonstrated superior performance when compared to benchmark index performance.

Signal latency assumptions in algorithm-based equity trading strategies have predisposed research and model biases towards low-latency, high frequency optimization. In an effort to create technologically derived signal arbitrage, academics and traders have recognized opportunities to take advantage of the fluidity of responses within the inadequate, though frequently assumed, efficient market hypothesis (EMH). This methodology deploys a high latency, low frequency corporate communication signal analysis derived from corporate-owned proprietary market rights on equity price performance. Specifically, the methodology measures competitive Peer Groups (or "Cohorts") of patent holding companies within the Russell 1000 and examine the equity price advantage of selecting fitness using a modification of a Genetic Algorithm (GA) augmented with Support Vector Regression (SVR), Particle Swarm Optimization (PSO) and measure effect modeling with Dynamic Time Warping (DTW) for directional performance estimation using Random Forest Regressors (RFR). For those unfamiliar with these techniques, the following definitions may be useful.

- A *Genetic Algorithm* is a biomimetic global optimization meta-heuristic based on haploid sexual reproduction. In M·CAM's instance, discrete patent portfolio descriptors represent genes; their interactivity within the IP ecosystem represents the chromosome; and qualitative scoring of originality represents fitness.
- *Support Vector Regression* is an extension of Support Vector Machines used for classification tasks. In a given set of labeled training examples belonging to two classes, an SVM uses a specified class of kernel function to transform the data to a higher dimensional product space where the two classes are linearly separable by a maximum margin hyperplane which is equidistant from both sets of points.
- *Particle Swarm Optimization* is a biomimetic global optimization meta-heuristic like GA but is much more efficient for solving over a continuous domain than a GA. This methodology is selected as it assists in providing a model for cohort dynamics associated with the creation of the IP ecosystem to understand prospective market responses.
- *Dynamic Time Warping* is used to find the expansions and contractions which most closely align two time series, t_1 and t_2. One way to frame the problem is to create a discrete grid such that one move along the x axis corresponds to a tick on t_1, and one move along the y axis corresponds to a tick on t_2.
- *Random Forests* are able to naturally include interaction terms while training, which greatly reduces the amount of effort needed to dedicate to feature selection and combination. The input data is highly dimensional, redundant and noisy because of the bag of features transformation performed. This synergizes very well with a Random Forest's strengths as each random feature subspace chosen for a tree by the RFR is likely to contain the information needed to make a useful prediction within, and also noise which is unique to, that subspace.

CNBC IQ 100 Index Powered by M·CAM Innovation α®

The CNBC IQ 100 Index Powered by M·CAM Innovation α® is established by identifying the 100 best Russell 1000 performers in the control and deployment of IP. These 100 companies are known as the "sentinel companies" and, as defined earlier, each has its own peer group of companies with similar patents. Rather than developing a capricious selection of equities based on marco classifiers, the CNBC IQ 100 Index is quantitatively selected and weighted based on a series of variables.

Selection

The CNBC IQ 100 Index begins with 100 of the best Russell 1000 performances in respect to their control and deployment of IP. The companies in each of the 100 sentinel companies' peer groups are ranked against their respective sentinel company on a quarterly basis. A positive ranking score indicates that a peer group company is expected to outperform its sentinel company for the following quarter; a similar argument follows for negative ranking scores. Conspicuously, a greater positive ranking implies that a company is likely to outperform its respective sentinel with a greater probability. Based on the editorial guidelines set by CNBC's editorial team, at least 90 percent of the index components must be finally selected from the Russell 1000 selection of companies. However, in the instance when a best-in-peer-group international or small to mid-cap company consistently outperforms the Russell 1000 sentinels, in those instances, up to 10 percent of the CNBC IQ 100 may come from a mix of international companies that trade in the United States as American Depository Receipts (ADRs) and selected small and mid-cap companies.

The ten highest rankings within unique peer groups then replace their respective sentinel companies in the portfolio on an annual basis. This new set of 100 portfolio positions will now serve as the 100 sentinel companies till the next FY. The CNBC IQ 100 Index is limited to ten replacements, or 10% of the portfolio positions, to reduce the frequency with which positions change within this index. Were this index to replace more positions at a greater frequency, each replacement would hold less weight for the CNBC news cycle. Moreover, this index requires that replacements be from unique peer groups to limit one peer group from being over-represented in the portfolio.

Weighting

Although the CNBC IQ 100 Index only changes its portfolio annually, the position weightings are rebalanced quarterly. This index seeks to overweight positions that are expected to outperform their respective sentinel company.

First, each position is given the same weight, 1%. Then, *x*% is removed from all the positions that are not expected to outperform their respective sentinel company (i.e., companies with ranking ≤ 0) where *x* is equal to the number of companies that are expected to outperform their respective sentinel. This *x*% is reallocated to the expected outperforming companies relative to the extent by which each is expected to outperform their respective sentinels. More concretely,

$$\text{outperformer weight} = 0.01 + \left(\frac{r_c}{\sum_S r_c}\right)\left(\frac{n_o}{100}\right),$$

$$\text{non-outperformer weight} = 0.01 - \left(\frac{1}{100-n_o}\right)\left(\frac{n_o}{100}\right)$$

where r_c = company ranking within its peer group, n_o = # of outperforming companies ($r_c > 0$), S = set of outperforming companies.

<u>Results and Discussion</u>

The following is the result of a backtest from July 14, 2007 to January 14, 2016. Portfolio returns were calculated using quarterly tick data as the index rebalances position weightings quarterly. The risk-free rate is set to be 5.11% – the yield of the 10-Y U.S. Treasury Note from July 13, 2007.[15] Additionally, this backtest accounts for survivorship bias by using the tick data of delisted companies that had made it into the index at one point or another.

Normal Distribution of Returns

A normal distribution of returns is particularly important as it will allow for a more accurate prediction of what returns are to be expected and serves as the basis for Modern Portfolio Theory (MPT).

Examining at the first four moments of a return distribution – mean, variance, skewness, and kurtosis – together will help in establishing a normal return distribution.

Table 1: *Moments of Return Distributions over Backtest*

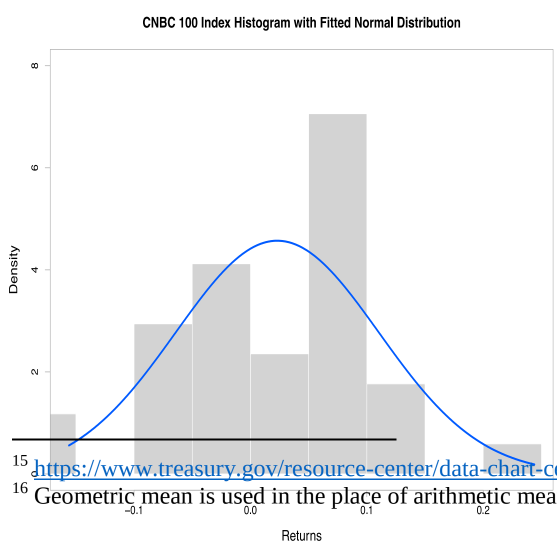
	CNBC IQ 100 Index	S&P 500
Geometric Mean[16]	0.0194	0.0063
Variance	0.0076	0.0062
Skewness	-0.0739	-0.3436
Kurtosis	2.9127	3.5134

Source: Purple Bridge Management, LLC
Data represents period 7/14/07–1/14/16

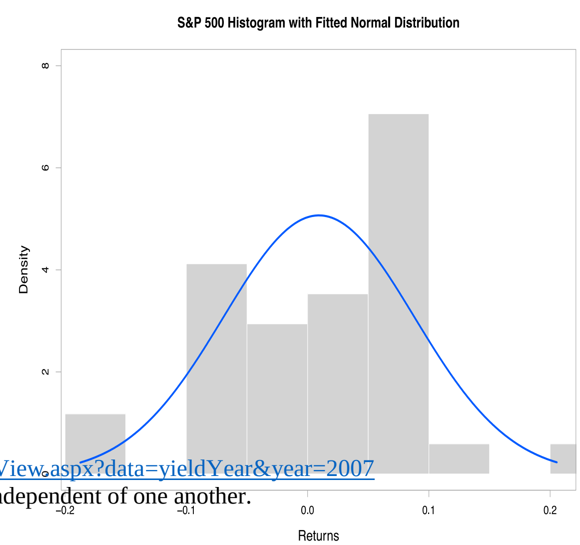
With kurtosis values fairly close to 3 and skewness values close to 0 for the CNBC IQ 100 Index and the S&P 500, it can be argued that both indices have adequately normal distributions for the purposes of MPT (***Table 1***).

***Figure* 1** affirms such distributions.

Figure 1: *Histograms of Returns with Fitted Normal Distributions*



Source: Purple Bridge Management, LLC
Data represents period 7/14/07–1/14/16



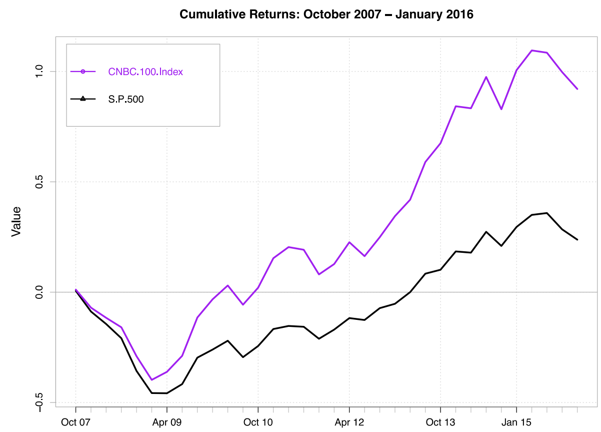
15 https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yieldYear&year=2007

16 Geometric mean is used in the place of arithmetic mean as quarterly returns are not independent of one another.

Performance Analysis

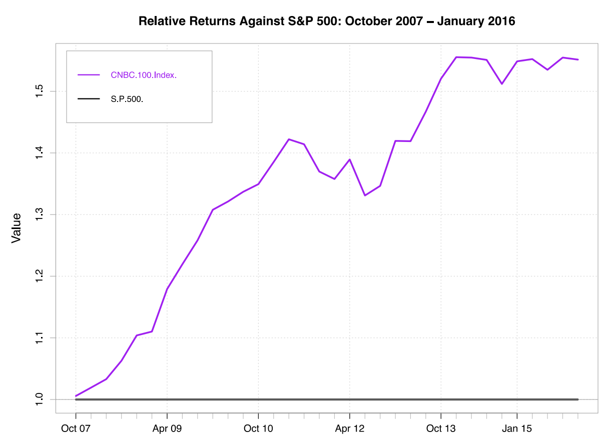
The CNBC IQ 100 Index employs a smart beta strategy in that it relies on an alternate index construction – both in position selection and weighting – to generate additional alpha against the S&P 500. Whenever possible, performance should be analyzed relative to the S&P 500. As such, while ***Figure* 2** shows that the CNBC IQ 100 Index enjoys cumulative returns of 92.05% relative to the S&P 500's 23.79%, ***Figure 3*** illuminates these returns more clearly. By plotting the CNBC IQ 100 Index returns relative to those of its benchmark, a relative return of 157.27% is apparent.

Figure 2: *Cumulative Returns through Backtest*



Source: Purple Bridge Management, LLC
Data represents period 7/14/07–1/14/16

Figure 3: *Relative Returns through Backtest*



Source: Purple Bridge Management, LLC
Data represents period 7/14/07–1/14/16

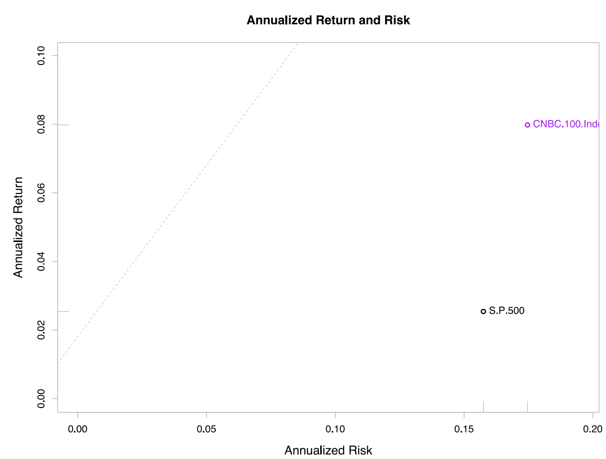
MPT's CAPM, first developed by William Sharpe in 1964, provides a framework with which an investor can quantitatively justify passive or active investing. ***Table 2*** shows that the CNBC IQ 100 Index generates a Risk Premium of 2.15% over this backtest by remaining nearly market-neutral to its benchmark as evidenced by its 1.07 Beta. Ultimately, this also generates an Alpha of 1.31% over the S&P 500. CAPM, a single-factor model based on risk, demonstrates that the CNBC IQ 100 Index does not take on significant risk to capture additional returns over both its risk-free asset and benchmark. This payoff between risk and return is seen in ***Figure 4***.

Table 2: *CNBC IQ 100 Index CAPM Quarterly Metrics*

	CNBC IQ 100 Index
Risk Premium	0.0215
Alpha	0.0131
Beta	1.0719
Bull Beta (β^+)	1.1059
Bear Beta (β^-)	0.8944
Timing Ratio[17]	1.2365
Annualized Sharpe Ratio	0.4205
Annualized Information Ratio	1.1830

Source: Purple Bridge Management, LLC
Data represents period 7/14/07–1/14/16

Figure 4: *Risk and Return Payoff*



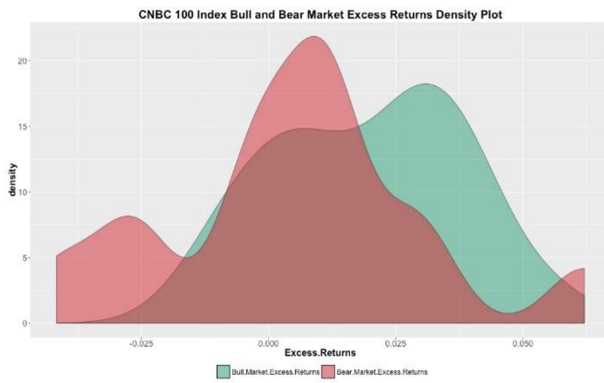
Source: Purple Bridge Management, LLC
Data represents period 7/14/07–1/14/16

The CNBC IQ 100 is roughly 10% more volatile than the S&P 500 in bull and bear markets separately, as evidenced by its β^+ and β^- values (***Table 2***). A Timing Ratio – a ratio of these two Beta values – of 1.24

[17] Timing Ratio $= \frac{\beta^+}{\beta^-}$; a Timing Ratio greater than 1 indicates that an investment strategy is good a timing asset allocation during bull markets and conversely for a Timing Ratio less than 1.

argues that this strategy is better at market timing during bull markets than during bear markets. provides a visualization of such a tendency. This figure illuminates the extent to which this index is able to capture additional returns over its benchmarks perhaps more clearly than the Timing Ratio does alone. Its excess returns during bear markets appear to be a roughly normal distribution centered just above 0%. Conversely, during bull markets this index's excess returns are relatively dense between just above 0% and 3.12%. In other words, this index is likely to outperform its benchmark modestly during downturns and more significantly so during market upswings.

Figure 5: *Excess Returns during Bull and Bear Markets*



A bull market is defined to be a quarter in which the S&P 500 had a positive return; a similar argument follows for a bear market. Excess Return = CNBC IQ 100 Index Return – S&P 500 Return.

Source: Purple Bridge Management, LLC
Data represents period 7/14/07–1/14/16