Measures Of Investor Sentiment: A Comparative Analysis Put-Call Ratio Vs. Volatility Index

Arindam Bandopadhyaya, University of Massachusetts-Boston, USA
Anne Leah Jones, University of Massachusetts-Boston, USA

ABSTRACT

Traditional research on asset pricing has focused on firm-specific and economy-wide factors that affect asset prices. Recently, the finance literature has turned to non-economic factors, such as investor sentiment, as possible determinants of asset prices (see for example, Fisher and Statman 2000 and Baker and Wurgler 2006). Studies such as Baek, Bandopadhyaya and Du (2005) suggest that shifts in investor sentiment may explain short-term movements in asset prices better than any other set of fundamental factors. A wide array of investor sentiment measures are now available, which leads us quite naturally to the question of which measure best mirrors actual market movements. In this paper, we begin to address this question by comparing two measures of investor sentiment which are computed daily by the Chicago Board Options Exchange (CBOE) and for which historical data are freely available on the CBOE website, thus making them ideal for use by both academics and practitioners studying market behavior: the Put-Call Ratio (PCR) and the Volatility Index (VIX). Using daily data from January 2, 2004 until April 11, 2006, we find that the PCR is a better explanatory variable than is the VIX for variations in the S&P 500 index that are not explained by economic factors. This supports the argument that, if one were to choose between these two measures of market sentiment, the PCR is a better choice than the VIX.

Keywords: Put-call ratio, VIX, Investor sentiment

1. INTRODUCTION

Traditional research on asset pricing has focused on firm-specific and economy-wide factors that affect asset prices. Recently, the finance literature has turned to non-economic factors, such as investor sentiment, as possible determinants of asset prices (see for example, Fisher and Statman 2000 and Baker and Wurgler 2006). Studies such as Baek, Bandopadhyaya and Du (2005) suggest that shifts in investor sentiment may explain short-term movements in asset prices better than any other set of fundamental factors. Eichengreen and Mody (1998) suggest that a change in one set of asset prices may influence investor sentiment and, especially in the short run, trigger changes in a seemingly unrelated set of asset prices, giving rise to pure contagion.

As the volume of studies that use investor sentiment to understand shifts in asset prices grows, so does the variety of investor sentiment measures. Dennis and Mayhew (2002) have used the P*ut-Call Ratio*, Randall, Suk and Tully (2003) utilize *Net Cash Flow into Mutual Funds*, Lashgari (2000) uses the *Barron's Confidence Index*, Baker and Wurgler (2006) use the *Issuance Percentage*, Whaley (2000) uses the *VIX-Investor Fear Gauge*, Kumar and Persaud (2002) employ the *Risk Appetite Index* (*RAI*), while Brown and Cliff (2005) use both the Bull-Bear Spread and the Investors Intelligence Survey. A more detailed list of studies that utilize these and other investor sentiment measures appears in Bandopadhyaya and Jones (2006).

The wide array of investor sentiment measures now available leads quite naturally to the question of which measure best mirrors actual market movements. In this paper, we begin to address this question by comparing two measures of investor sentiment which are computed daily by the Chicago Board Options Exchange (CBOE) and for which historical data are freely available on the CBOE website[1], thus making them ideal for use by both academics and practitioners studying market behavior: the Put-Call Ratio (PCR) and the Volatility Index (VIX). Steven Sears of the *Wall Street Journal*, for example, referred to both the PCR and the VIX in many of his commentaries on investor sentiment and capital market behavior (see Sears 2000a, 2000b, 2000c).

[1] www.cboe.com

The PCR is a ratio of investors betting on stock price drops versus investors betting on stock price increases (Dow Theory Forecasts 2003) and has been used in several academic studies as a measure of investor sentiment. Dennis and Mayhew (2002) use the PCR as a proxy for market sentiment when they study skewness in option prices while Guo (2004) uses the PCR as an indicator of market sentiment when studying Long-term Equity AnticiPation Securities (also known as LEAPs).

Practitioners also refer to the PCR when discussing market sentiment and they frequently use it as a contrarian investing tool. Oyster (1997) states "One of the most effective ways we can gauge investor sentiment … is by monitoring put/call ratios." Mark Arbeter (2007) cites the PCR when discussing investor sentiment and the behavior of the S&P 500 index. Both authors suggest that as the PCR rises, the market is likely to drop.

An alternative measure of investor sentiment, the VIX, is considered by the CBOE to be "the world's premier barometer of investor sentiment and market volatility."[2] It measures investor expectations for market volatility in the next 30 days as implied by the skew of S&P 500 index options, and has been dubbed the "Investor Fear Gauge"[3] When the VIX is high (i.e. when implied volatility is high), investor sentiment is presumed to be low since investors are assumed to be risk averse. Several academic papers have used the VIX as a measure of investor sentiment. Dash and Moran (2005) use the VIX as " a broad signal of investor sentiment" when studying hedge fund returns, while Banerjee et al. (2007) studies the relationship between the VIX and market returns for portfolios of stock based on beta, size, and the book-to-market ratio.

The VIX has appeal as an indicator of investor sentiment for practitioners as well. The *Wall Street Journal* reports on VIX movements regularly and their reporters feature it as a commentary on investor sentiment when they report on stock market or interest rate movements (see, for example, Ovide 2008, Ball 2007). It has also been featured in the Trading Techniques column of Futures Magazine (see Bittman 2007 and McEwan 2004) as a contrarian tool for timing the market. McEwan (2004) states that the VIX is "one of the best market timing tools available" while Copeland and Copeland (1999) uses the VIX to select optimal timing for value versus growth portfolio investing.

To investigate which of these two measures "outperforms" the other, we first use a random-walk model to see what portion of the variability in the daily movement of the S&P 500 index is explained by past values of the index itself. Arguably, past values of the index itself capture all relevant economic information that affects the index, especially if the data are high frequency. Any unexplained portion of the daily movement in the index must then be due to changes in other non-economic factors, such as changes in market sentiment. Using daily data from January 2, 2004 until April 11, 2006, we find that the PCR is a better explanatory variable than is the VIX for variations in the S&P 500 index that are not explained by economic factors. This supports the argument that, if one were to choose between the two measures of market sentiment, the PCR is a better choice than the VIX.

The rest of the paper is organized as follows. Section 2 describes the construction of the PCR and the VIX in some detail. Statistical properties of the two sentiment measures during the sample period are also discussed in this section. Section 3 outlines the methodology used and discusses the results obtained. Section 4 concludes.

2. THE PCR-PUT CALL RATIO AND THE VIX -INVESTOR FEAR GAUGE INDEX

PCR - Put Call Ratio

Several PCRs are used in the literature, but the most-utilized one is based on data collected by the CBOE. Each day, the CBOE adds together all of the call and put options that are traded on all individual equities, as well as on various indices, including the S&P 100, and computes: PCR = Volume of put option contracts / Volume of call option contracts. Buyers of put options are betting on stock price drops and may be considered pessimists. Buyers of call options are betting on stock price increases and may be considered optimists. Using trading volume as the basis of measurement, the PCR therefore reflects 'pessimism' as a percentage of 'optimism'. If the PCR is greater than one, then pessimists outweigh the optimists. If the PCR is less than one, then optimists outweigh the pessimists.

Although a value of 1.0 might seem to be a "neutral" reading, empirically it has been observed that there are more calls than puts bought on what would be considered an "average" day. As a result, a PCR of approximately 0.80 is considered "normal". Markets are considered "strong" when the ratio falls below 0.7 since

[2] www.cboe.com/micro/vix/introduction.aspx retreived March 7, 2008.
[3] See for example Whaley 2000 and www.cboe.com/micro/vix/faq.aspx

the optimists clearly outweigh the pessimists. Markets are considered "weak" when the ratio rises above 1.1 since the pessimists outweigh the optimists.

A plot of the put/call ratio during the chosen sample period (January 2004 through April 2006) appears in Exhibit 1, and the frequency distribution of put/call values is in Exhibit 2. The put/call ratio had a minimum and maximum value of 0.32 and 1.42, respectively, with a mean of 0.86097 and a standard deviation of 0.15147. The modal class in the frequency distribution is the 0.80-0.89 range. Out of the 574 days in the sample period, on 463 days the put/call reading was between 0.70 and 1.1, days when the market was "normal"; in 73 days the value fell below 0.7 ("strong" market), and in 100 days the put/call ratio was above 1.1 ("weak" market).

Exhibit 1: The Put/Call Ratio – January 2, 2004 through April 11, 2006

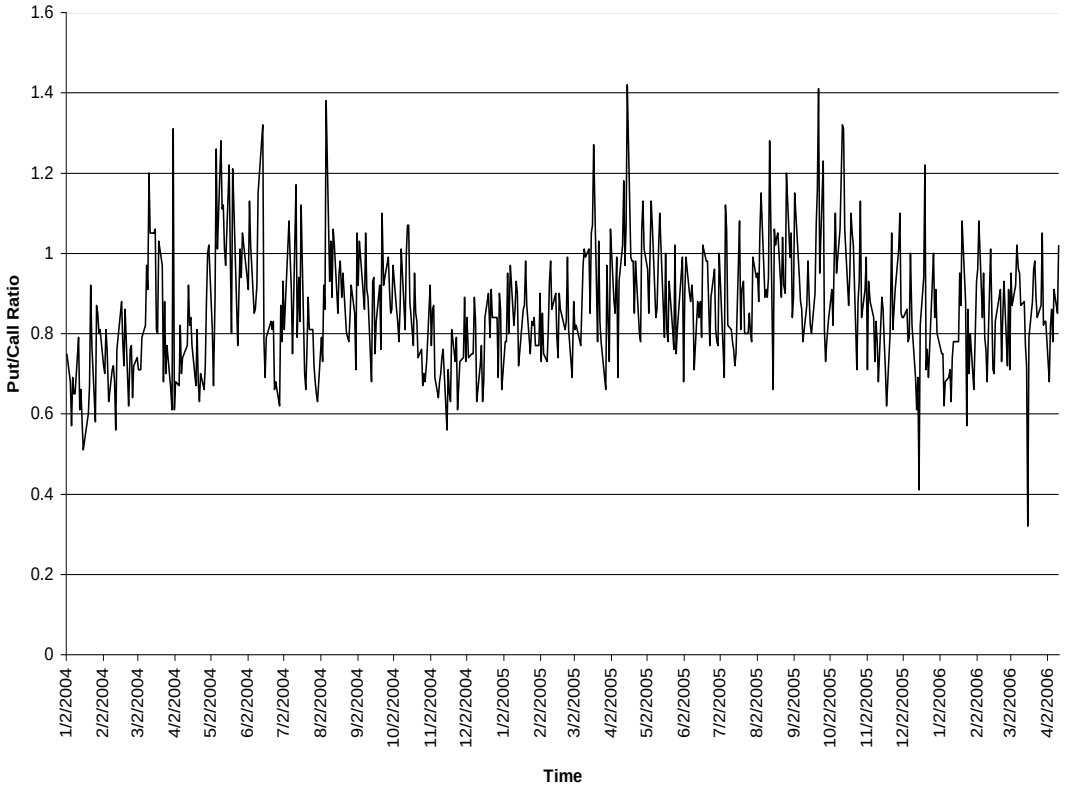
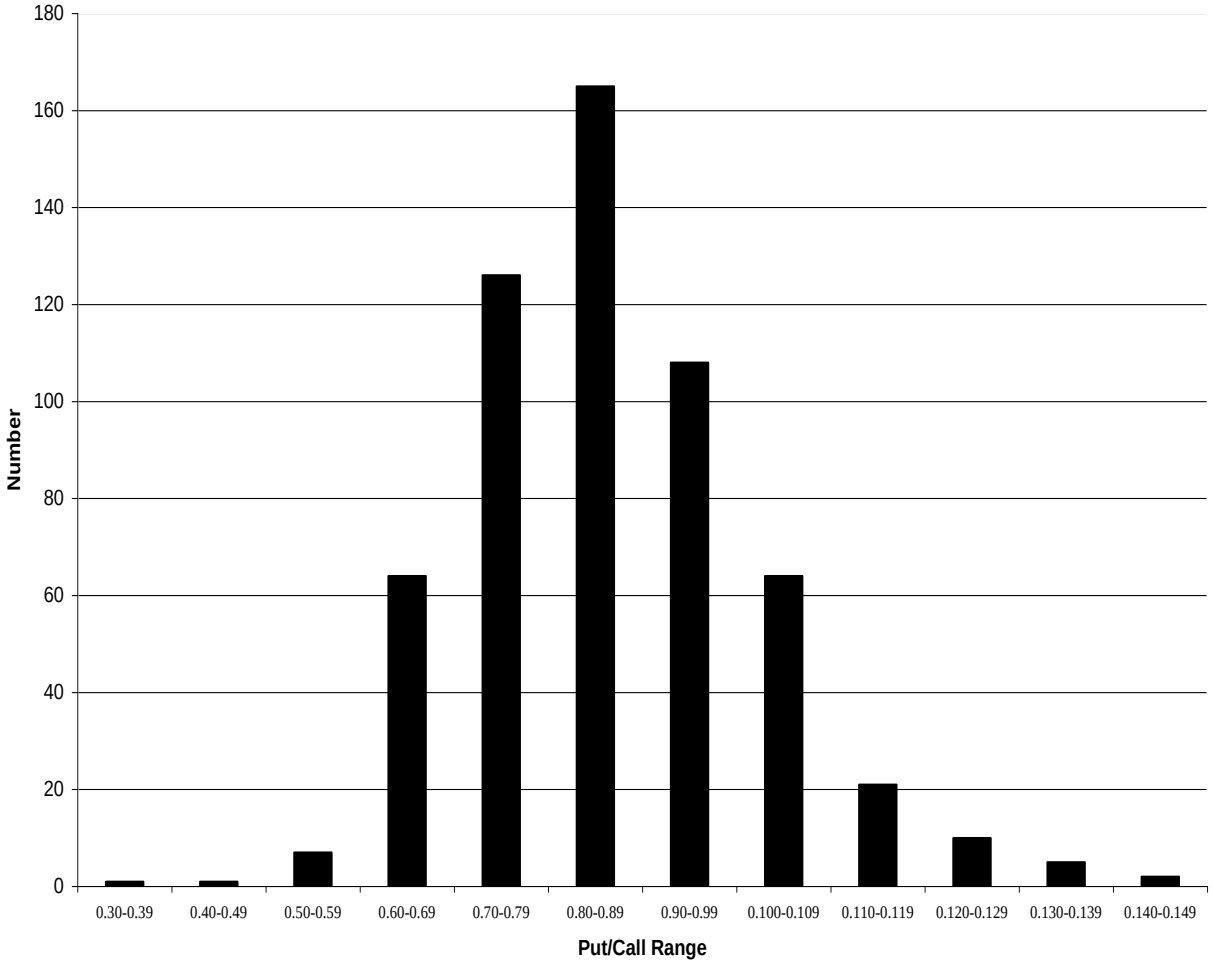


Exhibit 2: Put/Call Ratio Frequency Distribution - January 2, 2004 through April 11, 2006



VIX - Investor Fear Gauge

The VIX is constructed on any trading day directly derives expected near-term volatility using strike prices from a 'weighted strip of options' on the S&P 500 index.[4] A plot of the VIX in the sample period is in Exhibit 3. The VIX attained a minimum and maximum value of 10.23 and 21.58, respectively, with a mean of 13.8879 and a standard deviation of 2.1690. As expected, these values are generally slightly lower than those reported by Whaley (2000) because of the change in the VIX calculation since that study was published.[5] The frequency distribution of the computed VIX values (Exhibit 4) indicates that the modal range is 12%-13%.

[4] In 1993 the calculation of the VIX was altered. Prior to 1993 the VIX was calculated in the following manner: The implied volatilities of eighth-day near-the-money, nearby and second nearby options from the S&P 100 index were first computed using the Black-Scholes option pricing model. Nearby contracts were defined as ones with the shortest time but with at least eight calendar days to expiration and the second nearby contracts that expired in the adjacent month. (see Whaley 2000 for more details.) These volatilities were then appropriately weighted to characterize the implied volatility of a 22-trading-day at-the-money option contract on the S&P 100 index.

[5] www.cboe.com/micro/vix/faq.aspx#3 (retreived March 7, 2008) shows that during the time period studied by Whaley 2000 VIX levels were slightly lower when using the new methodology.

Exhibit 3: The Market Volatility Index - January 2, 2004 through April 11, 2006

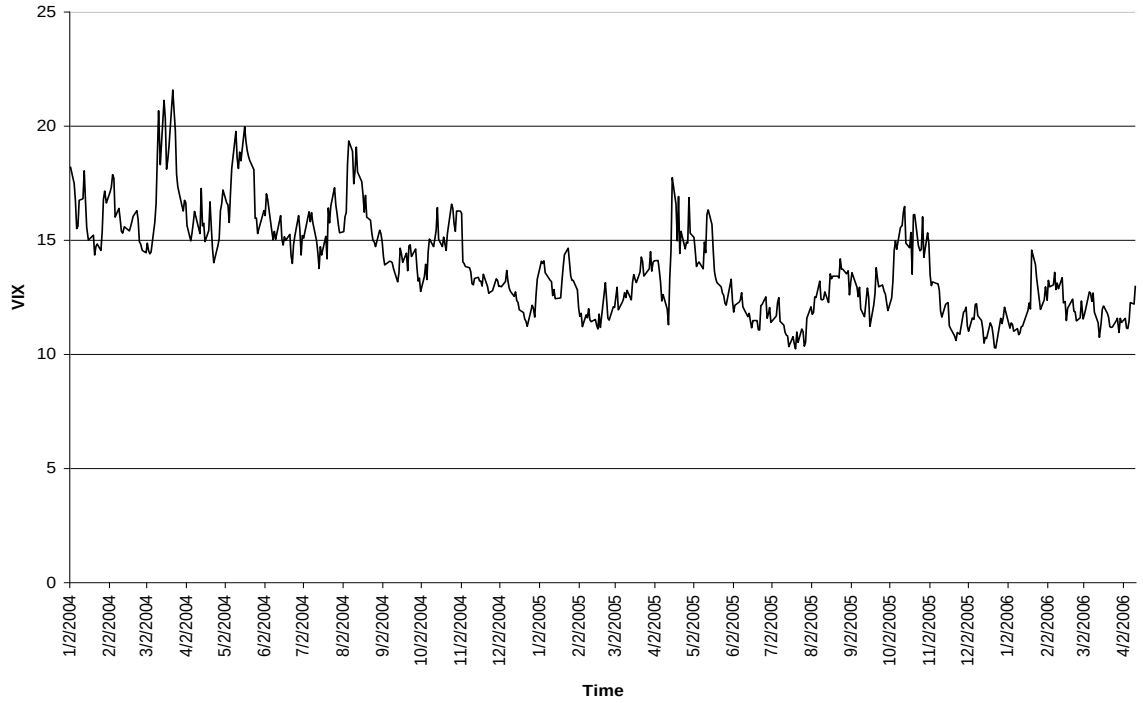
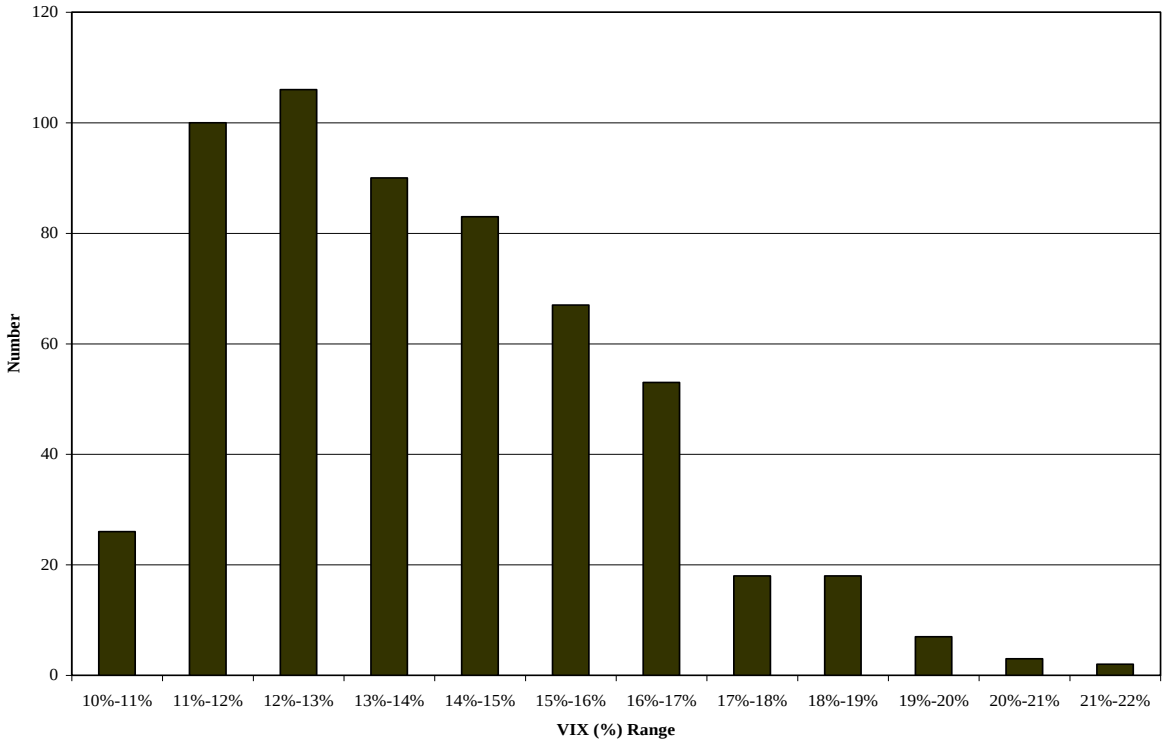


Exhibit 4: VIX Frequency Distribution - January 2, 2004 through April 11, 2006



3. METHODOLOGY AND RESULTS

In this section, we investigate the following question: between the PCR and the VIX, which is a "better" measure of investor sentiment? To begin, we first use a random-walk model to determine what portion of the variability in the daily movements of the S&P 500 index is explained by its own past values. Specifically, we estimate[6]:

$$(S\&P)_t = \beta_0 + \beta_1(S\&P)_{t-1} + Res_t \quad (1)$$

Results from the estimation of Equation (1) appear in Exhibit 5. Most notably, and perhaps not surprisingly, a vast majority of the variation in the S&P 500 index current-day value is explained by the value of the index the previous day, as evidenced by the extremely significant coefficient of $(S\&P)_{t-1}$ (t-statistic=182.4607) and a high value for the adjusted R-squared (0.9831). This is consistent with efficient markets where past values of the index itself capture all relevant economic information that affects the contemporaneous index values. However, any unexplained portion of the daily movement in the index must then result from changes in other non-economic factors. Thus, the residuals from the estimation of Equation (1), Res_t , could represent variations in the market due to non-economic factors; one such factor is investor sentiment, which indices such as the PCR and the VIX attempt to quantify.

Exhibit 5: Results from the Estimation of Equation (1)
$S\&P_t = \beta_0 + \beta_1\ S\&P_{t-1} + Res_t$

Variable	Coefficient	t-Statistic	p-Value
Constant	8.8128	1.3676	0.1720
$S\&P_{t-1}$	0.9928	182.4609	0.0000

N = 573
Adjusted R-Squared = 0.9832
Log-likelihood Ratio = -1983.004
F-Statistic = 33292.00

$S\&P_t$: S&P 500 Index at time t
Res_t : residual at time t

To investigate whether the PCR or the VIX better explains the residuals from the estimation of Equation (1), we estimate the following equations:

$$Res_t = \beta_0 + \beta_1(PCR)_t + \varepsilon_t \quad (2)$$

$$Res_t = \beta_0 + \beta_1(VIX)_t + \varepsilon_t \quad (3)$$

Since both the PCR and the VIX are commonly viewed as contrarian measures, we expect in each case that $\beta_1 < 0$.

Results from the estimation of Equations (2) and (3) appear in Exhibits 6 and 7, respectively. Results indicate that both the PCR and the VIX are significantly related to the residuals. Their coefficients also have the correct anticipated negative signs, implying that when these indices are higher, the S&P 500 moves lower.

[6] Results in this estimation, as well as in later estimations in this paper, are not qualitatively different if ln(S&P) is used. Also, results do not change significantly if the S&P 100 index is used in place of the S&P 500 index.

Exhibit 6: Results from the Estimation of Equation (2)
$\mathbf{Res}_t = \beta_0 + \beta_1 PCR_t + \varepsilon_t$

Variable	Coefficient	t-Statistic	p-Value
Constant	14.5922	8.2470	0.0000
PCR	-16.9447	-8.3735	0.0000

N = 573
Adjusted R-Squared = 0.1080
Log-likelihood Ratio = -1949.824
F-Statistic = 70.1154

Res_t : Residuals from Equation (1) at time t
PCR_t : Put/Call Ratio at time t

Exhibit 7: Results from the Estimation of Equation (3)
$(Res)_t = \beta_0 + \beta_1 (VIX)_t + \varepsilon_t$

Variable	Coefficient	t-Statistic	p-Value
Constant	11.39728	5.5488	0.0000
VIX	-0.821107	-5.6157	0.0000

N = 573
Adjusted R-Squared = 0.0508
Log-likelihood Ratio = -1967.602
F-Statistic = 31.5359

Res_t : Residuals from Equation (1) at time t
VIX_t : Market Volatility Index at time t

A comparison of the empirical results from testing Equations (2) and (3) shows, however, that the PCR has greater explanatory power than does the VIX. The adjusted R-squared for Equation (2), which is based on the PCR, is .06 points greater than that of Equation (3), which is based on the VIX. While the coefficients on both PCR_t and VIX_t have p-values of zero, the coefficient of PCR_t has a larger t-statistic than that of VIX_t (-8.37 versus -5.61). Moreover, the maximized likelihood is significantly larger for Equation (2) than for Equation (3) (-1949.824 versus -1967.602). Lastly, the F-statistic of joint significance of variables is greater for Equation (2) than for Equation (3) (70.1153 versus 31.53594).

4. CONCLUSION

Non-economic factors such as investor sentiment are increasingly being recognized as explanatory variables for analyzing asset prices. As the literature on market sentiment grows, so too does the array of competing measures. Since wide varieties of market sentiment measures are available, a deeper understanding of the relative merits of these indices offers insight in xxx In this paper we select two popular investor sentiment measures, the PCR and the VIX, and investigate which one of these does a better job of approximating non-economic factors that may be driving changes in asset prices. Using the residuals from a random-walk regression of the S&P 500 index to represent variations is assets prices not explained by economic factors, we find that the PCR is a better measure of such factors than is the VIX and thus the PCR is a better choice as a measure of market sentiment.

REFERENCES

1. Arbeter, Mark, (2007), Arbeter: Searching for a Bottom, *Business Week Online*, 00077135, 11/13/2007.
2. Baek, In-Mee, Arindam Bandopadhyaya and Chan Du, (2005), Determinants of Market Assessed Sovereign Risk: Economic Fundamentals or Market Risk Appetite?, *Journal of International Money and Finance*, Vol. 24, Issue 4, pp. 533-548.
3. Baker, Malcolm and Jeremy Stein, (2002), Market Liquidity as a Sentiment Indicator, Harvard Institute Research Working Paper, No. 1977.
4. Baker, Malcolm and Jeffrey Wurgler, (2006), Investor Sentiment and the Cross-section of Stock Returns, *Journal of Finance*, Vol 61, No. 4, pp. 1645-1680.
5. Ball, Yvonne, (2007), Credit Worries Spur Sharp Rise in Volatility, *Wall Street Journal*, November 8, 2007, Pg. C5.

6. Bandopadhyaya, Arindam and Anne Leah Jones, (2006), Measuring Investor Sentiment in Equity Markets, *Journal of Asset Management*, Vol 7, pp. 208-215.
7. Banerjee, Prithviraj, James Doran, and David Peterson, (2007), Imlied volatility and future portfolio returns, *Journal of Banking & Finance*, Vol. 31, pp. 3183-3199.
8. Branch, Ben, (1976), The Predictive Power of Stock Market Indicators, *Journal of Financial and Quantitative Analysis*, Vol. 11, Issue 2, pp. 269-286.
9. Brown, Gregory and Michael T. Cliff, Investor Sentiment and Asset Valuation, *Journal of Business*, Vol. 78:2 pp. 405-440.
10. Charoenrook, Anchada, (2003), Change in Consumer Sentiment and Aggregate Stock Market Returns, *The Owen Graduate School of Management, Vanderbilt University*, Working Paper.
11. Chopra, Navin, Charles M. C. Lee, Andrei Schleifer and Richard H. Thaler (1993), Yes, Discounts on Closed-End Funds Are a Sentiment Index, *Journal of Finance*, Vol. 48, pp. 801-808.
12. Copeland, Maggie and Thomas Copeland, (1999), Market Timing: Style and Size Rotation Using the VIX, *Financial Analysts Journal*, Vol.55:2, pp. 73-81.
13. Dennis, Patrick and Stewart Mayhew, (2002), Risk-Neutral Skewness: Evidence from Stock Options, *Journal of Financial & Quantitative Analysis*, 37 (3), pp. 471-493.
14. Eichengreen, Barry and Ashoka Mody, (1998), Interest Rates in the North and Capital Flows to the South: Is There a Missing Link?, *International Finance*, 1 (1), pp. 35-58.
15. Fisher, Kenneth L. and Meir Statman (2000), Investor Sentiment and Stock Returns, *Financial Analysts Journal*, 56 (2), pp. 16-23.
16. Fisher, Kenneth L. and Meir Statman, (2003), Consumer Confidence and Stock Returns, *Journal of Portfolio Management*, 30 (1), pp. 115-128.
17. Gongloff, Mark, (2008), Ahead of the Tape, *Wall Street Journal*, January 23, 2008, pg. C1.
18. Gup, Benton E., (1973) , "A Note on Stock Market Indicators and Stock Prices", *Journal of Financial & Quantitative Analysis*, 8 (4), pp. 673- 685.
19. Keim, Donald B. and Ananth Madhavan, (2000), The Relation between Stock Market Movements and NYSE Seat Prices, *Journal of Finance*, 55 (6), pp. 2817-2841.
20. Kumar, Manmohan S. and Avinash Persaud, (2002), Pure Contagion and Investors' Shifting Risk Appetite: Analytical Issues and Empirical Evidence, *International Finance*, 5 (3), 401-436.
21. Lashgari, Malek, (2000), The Role of TED Spread and Confidence Index in Explaining the Behavior of Stock Prices, *American Business Review*, 18 (2), pp. 9-11.
22. Lee, Charles, Andrei Schleifer and Richard H. Thaler, (1991), Investor Sentiment and the Closed-End Fund Puzzle, *Journal of Finance*, 46, pp. 75-109.
23. Neal, Robert and Simon M. Wheatley, (1998), Do Measures of Investor Sentiment Predict Returns?, *Journal of Financial & Quantitative Analysis*, 33 (4), pp. 523-548.
24. Oyster, Mike, (1997), Progressive acrophobia and the put/call ratio cure, *Futures: News, Analysis & Strategies for Futures, Options & Derivatives Traders*, August 1997, Vol 26:10.
25. Ovide, Shira, (2008), Fear Gauge Hits 5-Year High, And Some See It Rising More, *Wall Street Journal*, January 23, 2008, pg. C5.
26. Randall, Maury R., David Y. Suk, and Stephen W. Tully, (2003), Mutual Fund Cash Flows and Stock Market Performance, *Journal of Investing*, 12 (1), pp. 78-81.
27. Sears, Steven, (2000a), Options Traders Appear Unfazed in the Face Of Specter of Slowdown in Corporate Earnings, *Wall Street Journal*, October 4, 2000, pg. 1.
28. Sears, Steven, (2000b), Worries of Crash Push Volatility Index Higher As Traders Take Cover With Defensive Puts, *Wall Street Journal*, October 12, 2000, pg. 1.
29. Sears, Steven, (2000c), Traders Get Bullish With Heavy Call Activity In Attempt to Recover From Recent Setbacks, *Wall Street Journal*, October 23, 2000, pg. C16.
30. Swaminathan, B, (1996), Time-varying expected small firm returns and closed-end fund discounts, *Review of Financial Studies*, 9:845–87.
31. Whaley, Robert E., (2000), The Investor Fear Gauge, *Journal of Portfolio Management*, 26 (3).