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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. Some researchers (e.g., Eichengreen and Mody, 1998) suggest that a change in one set of asset prices may change investor sentiment, thus triggering changes in a seemingly unrelated set of asset prices, especially in the short run, giving rise to pure contagion. Fisher and Statman (2000) and Baker and Wurgler (2006) have also recognized that investor sentiment may be an important component of the market pricing process. In fact, some studies (see, e.g., 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.

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*, and Kumar and Persaud (2002) employ the *Risk Appetite Index* (*RAI*). A more detailed list of studies that utilize these and other investor sentiment measures appears in Exhibit 1.

The wide array of investor sentiment measures now available leads quite naturally to the question of which measures best mirror actual market movement. In this paper, I begin to address this question by picking two measures of investor sentiment, namely, the

Put-Call Ratio (PCR) and the VIX-Investor Fear Gauge (VIX). These measures are computed daily by the Chicago Board Options Exchange (CBOE) and are widely used by academicians and practitioners as measures of investor sentiment to gauge the prevailing level of bullishness or bearishness in the market. In most cases these indicators are used as contrarian tools: when market participants are most bullish, the likelihood of a downside reversal is greatest; when investors become overly bearish, a market rally may be on the horizon.

To investigate which of these measures "outperforms" the other, I 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 2004 until the middle of 2006, I 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 as a measure of market sentiment, then 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 Put Call Ratio and the VIX Investor Fear Gauge Index

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.

On days when the major averages perform strongly, the number of calls bought typically far outweighs the number of puts, resulting in a relatively low put/call ratio. On days when the market is weak, the number of puts bought generally outnumbers the purchase of calls. 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 and "weak" when the ratio rises above 1.1.

A plot of the put/call ratio during the chosen sample period (January 2004 through April 2006) appears in Exhibit 2, and the frequency distribution of put/call values is in Exhibit 3. 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).

The VIX is constructed on any trading day using the implied volatilities of options on equities in the S&P 100 index. The implied volatilities of eighth-day near-the-money, nearby and second nearby options from the S&P 100 index are first computed using the Black-Scholes option pricing model.[1] These volatilities are then appropriately weighted to characterize the implied volatility of a 22-trading-day at-the-money option contract on the S&P 100 index. A plot of the VIX in the sample period is in Exhibit 4. 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. The frequency distribution of the computed VIX values (Exhibit 5) indicates that the modal range is 12%-13%.

3. Methodology and Results

In this section, I investigate the following question: between the PCR and the VIX, which is a "better" measure of investor sentiment? To begin, I 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, I estimate[2]:

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

Results from the estimation of equation (1) appear in Exhibit 6. 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

[1] Nearby contracts are defined as ones with the shortest time. But with at least eight calendar days to expiration and the second nearby contracts that expire in the adjacent month. For a more detailed exposition of the construction of the VIX see Whaley (2000).

[2] 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.

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, 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 approximate.

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

$$(Res)_t = \beta_0 + \beta_1(PCR)_t + \varepsilon_t \qquad (2)$$

$$(Res)_t = \beta_0 + \beta_1(VIX)_t + \varepsilon_t \qquad (3)$$

Results from the estimation of equations (2) and (3) appear in Exhibits 7 and 8, 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 the higher these indices are, the lower the market sentiment is. However, a comparison of the results from the two equations shows that the PCR has a greater explanatory power than does the VIX. The co-efficient of the PCR is greater in magnitude than that of the VIX (-16.94 versus -0.82), and while both the PCR and the VIX have a p-value of zero, the co-efficient of the PCR has a larger t-statistic than that of the VIX (-8.37 versus -5.61). Moreover, equation (2) is a better fit than is equation (3) because:

1. the adjusted R-squared is greater (0.1079 versus 0.0508)
2. the maximized likelihood is larger (-1949.824 versus -1967.602)
3. the F-statistic of joint significance of variables is greater (70.1153 versus 31.53594).

4. Conclusion

Non-economic factors such as investor sentiment are increasingly becoming important explanatory variables in 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 In this paper, I select two popularly utilized investor sentiment measures, the PCR and the VIX, to investigate which one of these outperforms the other in approximating non-economic factors that may be driving changes in asset prices. Using residuals from a random-walk equation of the S&P 500 index to represent variations is assets prices not explained by economic factors, I find that the PCR is a better measure of such factors than is the VIX and thus that the PCR is a better choice as a measure of market sentiment.

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Exhibit 1: Measures of Market Sentiment Used in Prior Research

Name	How Measured	Studies
1. Optimism/Pessimism about the Economy		
Index of Consumer Confidence	Survey by Conference Board www.conferenceboard.org	Fisher and Statman (2003)
Consumer Confidence Index	Survey by U Mich.- monthly	Charoenrook (2003) Fisher and Statman (2003)
2. Optimism/Pessimism about the Stock Market		
Put/Call Ratio	Puts outstanding / Calls outstanding	Dennis and Mayhew (2002)
Trin. Statistic	Vol Decl issues/# Decl / Vol Adv issues/# Adv	NO ACADEMIC REF
Mutual Fund Cash Positions	% cash held in MFs	Gup (1973) Branch (1976)
	Net cash flow into MF's	Randall, Suk, and Tully (2003)
Mutual Fund Redemptions	Net redemptions/total assets	Neal and Wheatley (1998)
AAII Survey	Survey of individual investors	Fisher & Statman (2000) Fisher & Statman (2003)
Investors Intelligence Survey	Survey of newsletter writers	Fisher & Statman (2000)
Barron's Confidence Index	Aaa yield – Bbb yield	Lashgari (2000)
TED Spread	Tbill futures yield – Eurodollar futures yield	Lashgari (2000)
Merrill Lynch Survey	Wall St. sell-side analysts	Fisher & Statman (2000) Fisher & Statman (2003)

Exhibit 1 (Continued): Measures of Market Sentiment Used in Prior Research

Name	How Measured	Studies
3. Riskiness of the Stock Market		
Issuance %	Gross annual equities issued Gross ann. debt & equ. issued	Baker & Wurgler (2006)
RIPO	Avg. ann. first-day returns on IPO's	Baker & Wurgler (2006)
Turnover	Reported sh.vol./avg shs listed NYSE (logged & detrended)	Baker & Wurgler (2006)
Closed-end Fund Discount	Y/E, value wtd. avg. disc. on closed-end mutual funds	Baker & Wurgler (2006) Neal and Wheatley (1998) Lee, Schleifer, & Thaler (1991) Chopra, Lee, Schleifer, & Thaler (1993)
Market Liquidity	Reported share volume Avg # of shares	Baker & Stein (2002 WP)
NYSE Seat Prices	Trading volume or quoted bid-ask spread	Keim and Madhavan (2000)
4. Riskiness of an individual stock		
Beta	CAPM	Various
5. Risk Aversion		
Risk Appetite Index	Spearman Rank correlation volatility vs. excess returns	Kumar and Persaud (2002)
VIX – Investor Fear Gauge	Implied option volatility	Whaley (2000)

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

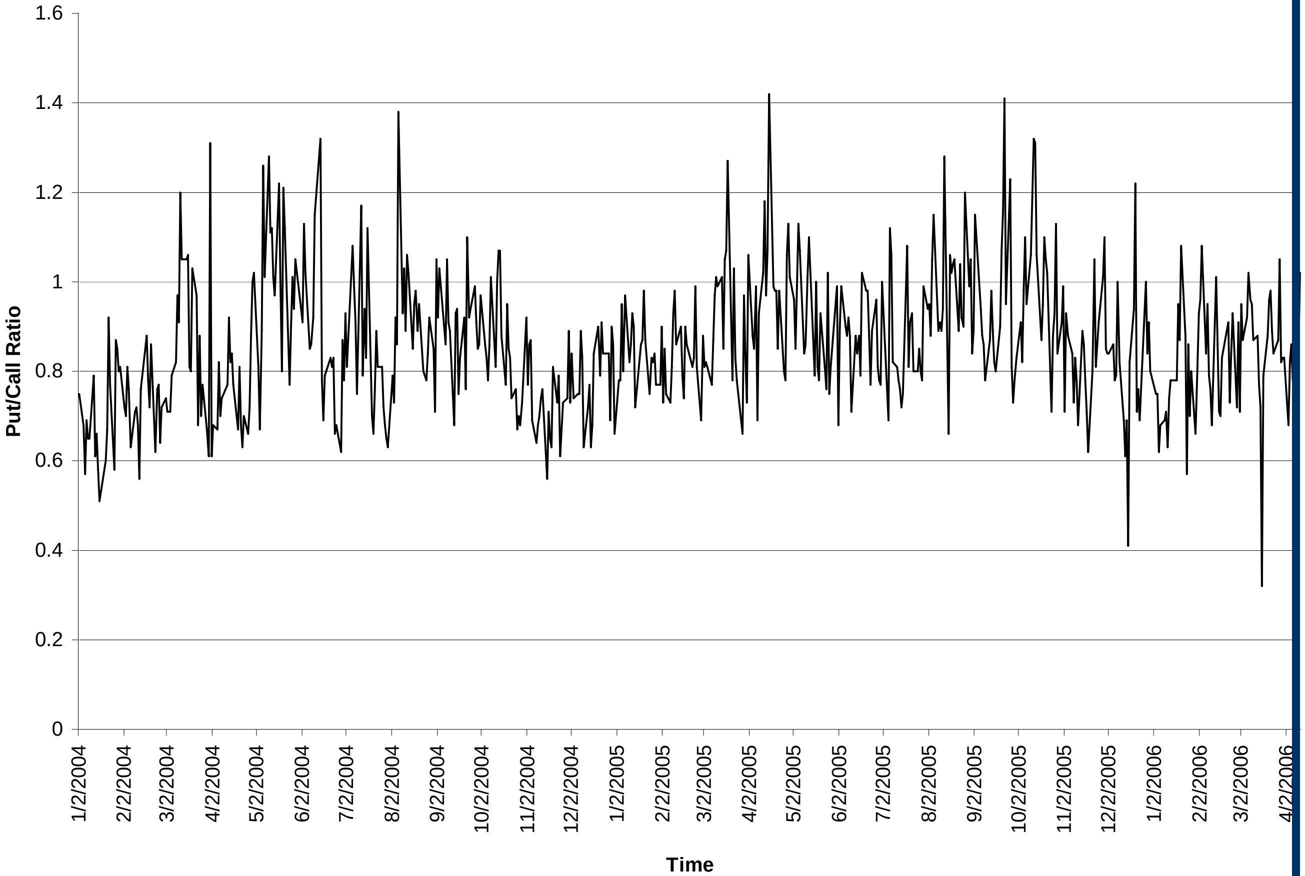

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Exhibit 3: Put/Call Ratio Frequency Distribution

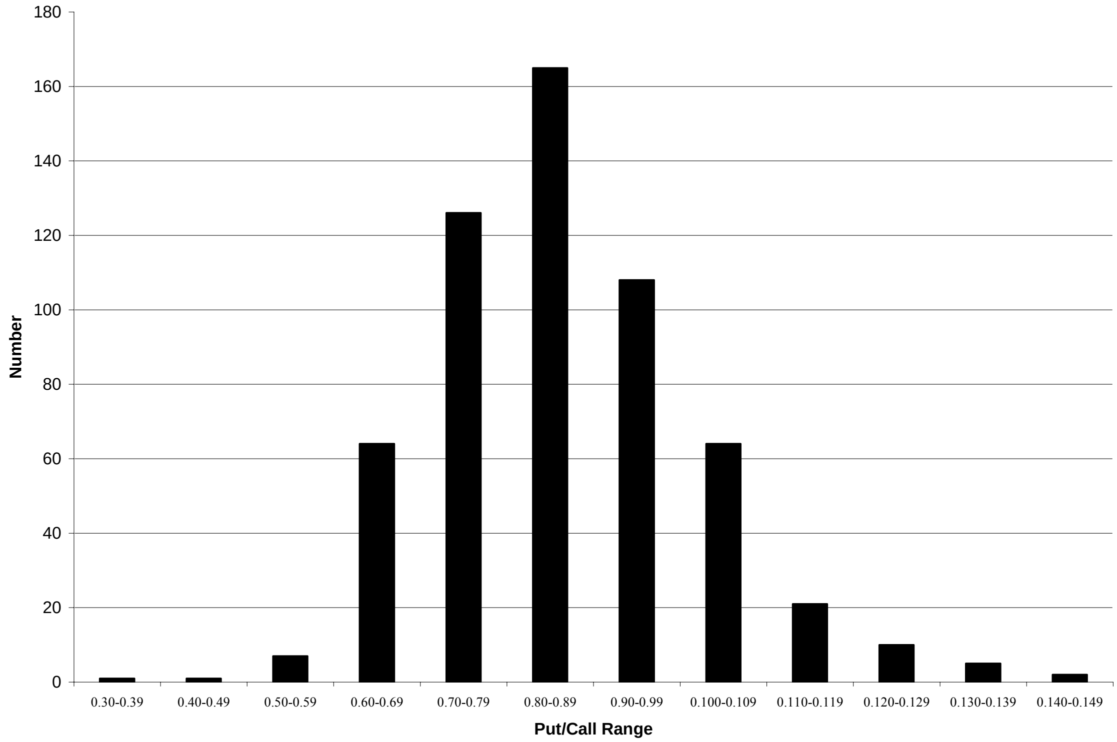

Exhibit 4: The Market Volatility Index - January 2, 2004 through April 11, 2006

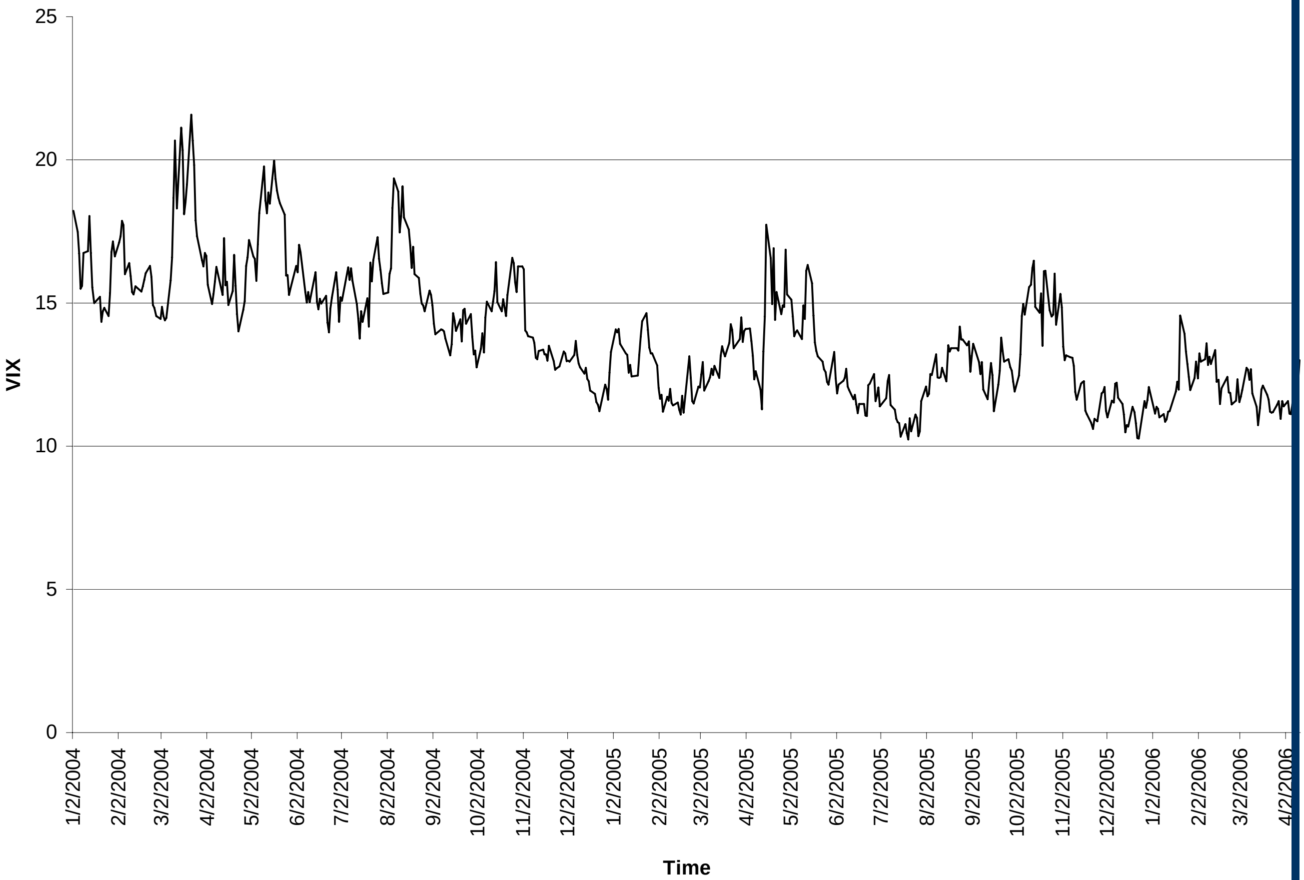

Exhibit 5: VIX Frequency Distribution

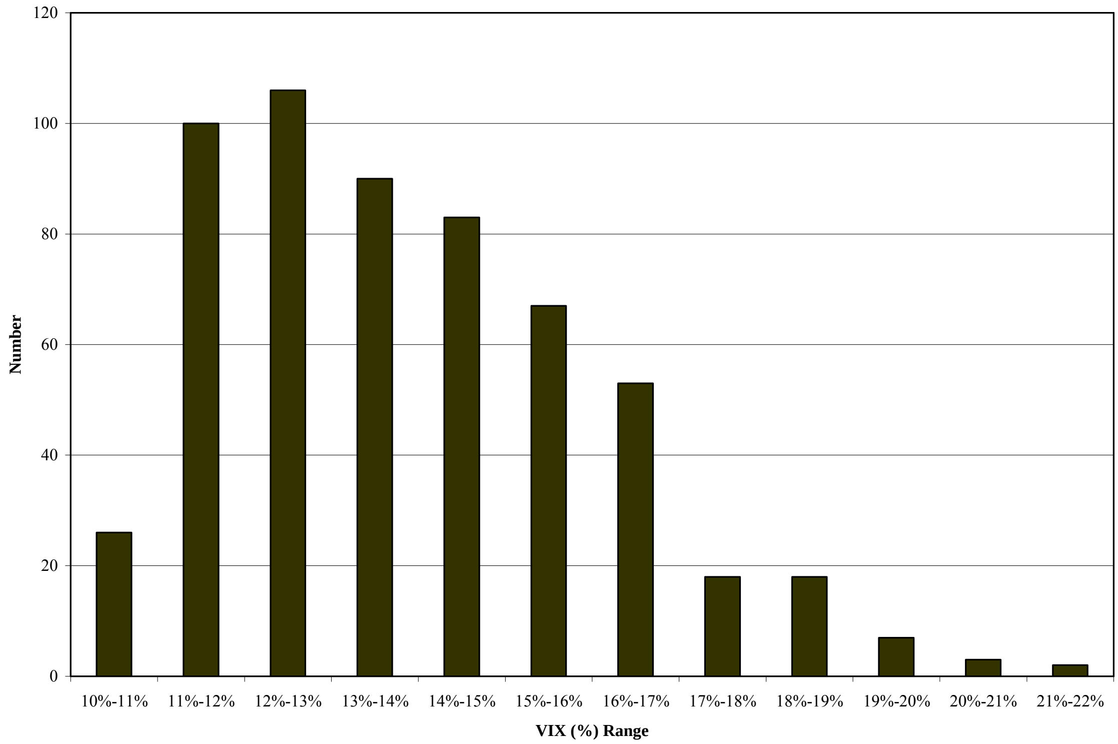

Exhibit 6: Results from the Estimation of Equation (1)

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

S&P = S&P 500 Index

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

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

Exhibit 7: Results from the Estimation of Equation (2)

$$(Res)_t = \beta_0 + \beta_1 (PCR)_t + \varepsilon_t$$

RES = Residuals from Equation (1)
PCR = Put/Call Ratio

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

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

Exhibit 8: Results from the Estimation of Equation (3)

$$(Res)_t = \beta_0 + \beta_1 (VIX)_t + \varepsilon_t$$

RES = Residuals from Equation (1)
VIX = Investor Fear Gauge

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

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