Investor Sentiment and Timberland Investment Returns

Wenjing Yao
Baodong Cheng
Bin Mei

Abstract

We use the orthogonalized investor sentiment index formed by M. Baker and J. Wurgler (*J. Financ*. 61(4):1645–1680, 2006) to examine the relationship between investor sentiment and timberland investment returns. The empirical results show that current investor sentiment is an important factor that determines the one-quarter future returns of timberland investment, and the predicting power persists over the next 1 to 5 years. Both the short- and long-term studies obtain negative coefficients on investor sentiment, indicating that current increase in investor sentiment drives prices up and lowers future returns. In addition, significantly different return variances and insignificantly different average returns of timberland investment are obtained between low- and high-sentiment periods. The result further confirms the ability of earning long-term stable returns by timberland investment.

As an investment vehicle, timberland assets are good candidates for portfolio diversification because of their weak correlation with the market and low systematic risk (Lonnstedt and Svensson 2000, Zinkhan and Cubbage 2003, Healey et al. 2005, Newell and Eves 2009, Waggle and Johnson 2009). In the United States, institutional investors such as pension funds, investment banks, endowments, and foundations have diversified their investments from traditional financial assets to timberland assets for long-term stable returns since the 1980s. In 2010, the total value of timberland properties held by institutional investors was approximately $30 billion (Harris et al. 2010).

Institutional investors seek professional management of timberland properties from timberland investment management organizations (TIMOs). TIMOs are responsible for searching proper timberland investment properties and managing them to achieve adequate returns. Timberlands are illiquid assets with the length of investment horizons typically being 10 to 15 years (Clutter et al. 2005). To provide financial information about timberland investment, the National Council of Real Estate Investment Fiduciaries (NCREIF), together with several TIMOs, published the NCREIF Timberland Index (NTI) in 1992 (Binkley et al. 2003). Based on the quarterly and yearly NTI data dating back to 1987, the financial performance of timberland assets has been examined by several studies (Sun and Zhang 2001, Cascio and Clutter 2008, Liao et al. 2009, Mei and Clutter 2010, Rockemann and Schiereck 2010, Clements et al. 2011, Yao et al. 2014, Yao and Mei 2015). Most of these studies relied on traditional financial and time series models, which assume that only systematic risks affect asset returns. However, empirical results of significant abnormal returns indicate that those systematic risk factors have limited predicting power on timberland investment returns. Several studies found that some nonsystematic risks also have effects on timberland investment returns. Gao and Mei (2013) used the Internet search volume of timberland related terms to test investor attention on timberland asset pricing and found significant relationships between investor attention and the abnormal returns of timberland investments. Recent studies on behavioral finance argue that irrational investors in the market have an important effect on stock prices. Investor sentiment, which captures the irrationality in the naive and individual investors, has been found to be significantly related to stock returns (Brown and Cliff 2005, Baker and Wurgler 2006, Schmeling 2009).

This study contributes to literature by studying the relationship between investor sentiment and private-equity timberland investment returns. Our goal was to examine the predicting power of investor sentiment on the short- and

The authors are, respectively, Instructor, Dept. of Mathematics, Univ. of Oregon, Eugene (wenjingy@uoregon.edu); Professor, School of Economics and Management, Beijing Forestry Univ., Beijing, China (baodongcheng@163.com); and Associate Professor, Warnell School of Forestry and Natural Resources, Univ. of Georgia, Athens (bmei@uga.edu [corresponding author]). This paper was received for publication in April 2015. Article no. 15-00013.

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long-term timberland investment returns by using an indirect sentiment index. The performances of timberland investment in low- and high-sentiment periods were studied and are compared in this article.

Literature Review

In the classical finance theory, competition among rational investors will lead to market equilibrium where assets' prices are determined by the rationally discounted value of cash flows. The modern portfolio theory states that the expected returns of portfolios depend only on systematic risks. However, Baker and Wurgler (2006) present evidence that sentiment plays a significant role in determining the cross-sectional changes of stock returns. Sentiment generally indicates an individual's degree of optimism and pessimism about future environment. Investor sentiment, in particular, is the propensity to invest in the financial markets by the optimistic or pessimistic individual investors (Akhtar et al. 2012). Empirical studies have been conducted to explore the role of investor sentiment in the stock market. Some results show that investor sentiment is contemporaneously positively correlated with excess returns in the short term (Lee et al. 1991, Brown and Cliff 2004). In the long run, future returns of stocks are negatively correlated with sentiment (Brown and Cliff 2005). The noise traders model, from the theoretical work of Delong et al. (1990), indicates that changes in the sentiment of noise traders are related to asset pricing. Fisher and Statman (2000) find that changes in the sentiment of individual investors and newsletter writers are highly correlated but not perfectly. However, there is no correlation between changes in the sentiment and institutional investors.

The sentiment proxies can be divided into direct and indirect ones. Direct sentiment proxies of the market include the survey conducted by the American Association of Individual Investors and the Investor Intelligence (Lee et al. 2002). On the other hand, there are several indirect sentiment proxies. The most widely used one is the closed-end fund discount (CEFD), which is the average difference between the net asset values of closed-end funds and their market prices. It is found to be inversely related to sentiment (Lee et al. 1991, Swaminathan 1996, Neal and Wheatley 1998). The New York Stock Exchange (NYSE) share turnover is the ratio of reported share volume to the average number of shares listed from the NYSE Fact Book. The share volume, which represents liquidity and is regarded as a sentiment proxy, is found to be able to forecast market returns (Jones 2001, Baker and Stein 2004). Moreover, the first-day returns and number of initial public offerings (IPOs) are good indicators of sentiment because they are sensitive to the stock market (Brown and Cliff 2005, Baker and Wurgler 2006, Cornelli et al. 2006). Other indirect sentiment proxies include measures based on market performance such as the ratio of the number of advancing issues to that of declining issues, type of trading activity (e.g., the percent change in margin borrowing and the percent change in short interest), variables related to derivatives trading activities (e.g., the ratio of Chicago Board of Exchange equity put-to-call trading volume), and the dividend premium (Brown and Cliff 2004, 2005; Baker and Wurgler 2006). Baker and Wurgler (2006) claim that the current proxies for sentiment are not perfect and are controversial. They approximate investor sentiment using the first principle component of a number of indirect sentiment proxies and find the approximated sentiment index has a significant effect on the cross-sectional changes of stock returns.

To examine the relationship between sentiment and returns, linear regression models are used by Barberis et al. (2005), Brown and Cliff (2005), and Akhtar et al. (2012). Brown and Cliff (2004) use the vector autoregressive (VAR) model to test how sentiment interacts with market returns and identify a causal relationship. Lee et al. (2002) use the generalized autoregressive conditional heteroscedasticity-in-mean specification to test the effect of noise trader risk and find sentiment is a systematic risk factor that should be priced.

Methodology

Short-term return predictability

To investigate the short-term return predictability of investor sentiment on timberland assets, we apply the VAR model. Through the VAR model, the short-term interactions between investor sentiment and timberland investment returns are examined. The model is estimated as follows

$$R_t = \phi_0 + \Phi_1 R_{t-1} + \cdots + \Phi_p R_{t-p} + a_t \qquad (1)$$

where R_t is a k-dimensional vector of asset return, sentiment index, and returns of control variables; ϕ_0 is a k-dimensional vector; Φ_j is a $k \times k$ matrix, where j can be 1, 2, . . . , p; and $\{a_t\}$ is a sequence of serially uncorrelated random vectors with mean zero and covariance matrix Σ. To determine the number of order p, selection criteria such as the Akaike information criterion (AIC), Hannan-Quinn information criterion (HQ), and Schwarz information criterion (SC), are used. Under the null hypothesis, behavioral forces have no influence on asset valuations. That is, investor sentiment has no significant effect on asset returns. Under the alternative hypothesis, overreactions caused by current optimism would increase asset prices and thus lower the subsequent future returns. Accordingly, negative coefficients on sentiment are expected. Brown and Cliff (2005) claim that control variables that capture the rational predictability of asset returns should be included because investors' reactions to the market can be a combination of rational reflections of the market and irrational expectations for the future. Sentiment variables may contain information from risk factors that are used to predict assets' future performance. Thus, to examine the predictability of sentiment on asset returns, the irrational part of sentiment variables is tested by incorporating the systematic risks induced by several control variables. On the other hand, investor sentiment may be affected by market performance. Therefore, the effect of timberland market on the sentiment is also tested by the VAR system.

Long-term return predictability

Intuitively, a bullish market attracts more investment, and investors become more optimistic about the market. The effect of sentiment can be persistent. Therefore, investor sentiment may show some importance in predicting long-term returns. The relationship between long-term timberland investment returns and investor sentiment is examined by the following regression.

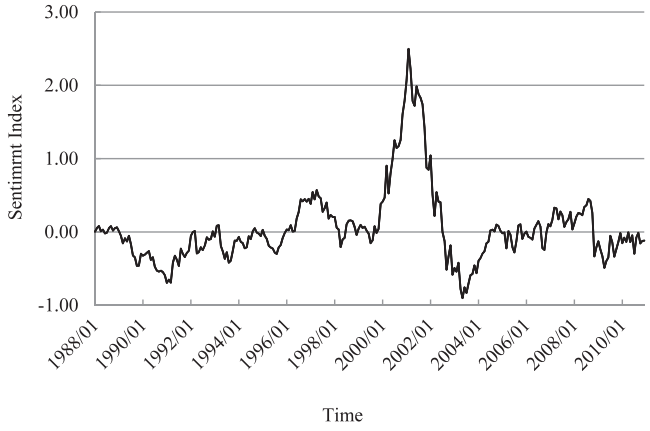

Figure 1.—Historical pattern of the monthly orthogonalized investor sentiment index from 1988 to 2010.

$$(R_{i,t+1} + R_{i,t+2} + \cdots; + R_{i,t+k})/k = \alpha_i^k + \beta_i^k S_t + \sum_{q=1}^{p} \gamma_q^k Z_{q,t} + \varepsilon_i^k \quad (2)$$

where $R_{i,t+1}$, $R_{i,t+2}$, . . . $R_{i,t+k}$, are the successive k period future log returns of asset i; S_t and $Z_{q,t}$ are the sentiment index and control variables at time t; and α_i^k and ε_i^k are the intercept and error term of the regression. Parameters β_i^k and γ_q^k are the sensitivity coefficients on the sentiment index and control variables. Similarly, the null hypothesis indicates that β_i^k is not significantly different from 0; while the alternative hypothesis states that β_i^k is negative.

Nevertheless, the method of generating the multiperiod future returns causes an econometric problem. Strong serial correlation in the residuals will be produced after running the ordinary least squares (OLS) regression of overlapping dependent variables so the asymptotic assumptions of the OLS are violated. Although the coefficient estimates are unbiased with serial correlations, the estimated standard errors calculated by the OLS formula are incorrect. To fix the problem, the Newey-West serial correlation consistent standard errors are calculated (Newey and West 1987). The corresponding Newey-West t statistics are calculated as the ratio of the coefficient estimate and the Newey-West standard error.

Asset performance in low- and high-sentiment periods

Previous studies indicate that sentiment investors are reluctant to sell short, and these investors are found to be more active in the run-up market. There is also evidence showing that sentiment investors check their portfolios more frequently during high-sentiment periods than in low-sentiment periods (Yuan 2008, Karlsson et al. 2009). Thus, stocks or portfolios may perform differently with respect to low- and high-sentiment periods. To study the financial performance of timberland investment in different sentiment periods, the average returns of timberland investment as well as the variances of returns are compared. However, the widely used Student's t test is not appropriate here because the sizes and variances of the two samples are usually different. To solve the problem, the Welch's t test is adapted to the Student's t test (Welch 1947).

Data

The NCREIF Timberland Index

Provided by the NCREIF, the NTI tracks total returns from a large sample of geographically diverse timberland properties in the United States. As of 2014Q2, the NTI represented over 13 million acres with a market value of about $23 billion (NCREIF 2014). The NTI includes both income return,[1] which comes from operating activities such as timber sales, and capital appreciation, which is from the partial or complete property sales and/or appraisals if the property is not completely sold during the period.

The formulas used to calculate the index are

$$\mathrm{IR}_t = \frac{\mathrm{EBITDDA}_t}{\mathrm{MV}_{t-1} + 0.5(\mathrm{CI}_t - \mathrm{PS}_t + \mathrm{PP}_t - \mathrm{EBITDDA}_t)} \quad (3)$$

$$\mathrm{CR}_t = \frac{\mathrm{MV}_t - \mathrm{MV}_{t-1} - \mathrm{CI}_t + \mathrm{PS}_t - \mathrm{PP}_t}{\mathrm{MV}_{t-1} + 0.5(\mathrm{CI}_t - \mathrm{PS}_t + \mathrm{PP}_t - \mathrm{EBITDDA}_t)} \quad (4)$$

where IR_t and CR_t are the income return and capital return, respectively; CI_t equals the capitalized expenditures (e.g., forest regeneration); PS_t equals the net proceeds from land sales; PP_t equals the gross costs of new land acquisitions; and MV_t equals the market value of the property (Binkley et al. 2003).

Owing to the fee-based nature of the NTI, the gross returns measured by the NTI are before investment advisory fees. In addition, the NTI excludes the effects of leverage. To deal with these concerns, the NCREIF released the Timberland Fund and Separate Account Index (NTF) in 2012. The NTF reflects returns of a portfolio of timber funds and accounts and is available both gross and net of fees back to 1988Q1 (NCREIF 2012). In this study, the net of fees NTF is used to represent real business returns of timberland investments. For both the NTI and NTF, logarithm is taken for the return data.

Investor sentiment

To proxy investor sentiment, the monthly orthogonalized investor sentiment index constructed by Baker and Wurgler (2006) is used and compounded into quarterly data. The composite index of sentiment is formed from the first principle component of six lead or lag underlying proxies for sentiment. The six sentiment measures include the CEFD, the NYSE share turnover, the first-day returns of IPOs, the number of IPOs, the share of equity issues in total equity and debt issues, and the dividend premium. By principle component analysis, the idiosyncratic noise and non–sentiment-related components are filtered out and common variation is captured. Moreover, to distinguish a common sentiment component and a common business cycle component, the business cycle variation from each sentiment proxy is removed prior to the principle component analysis.[2] Figure 1 plots the monthly orthogonalized investor sentiment index from 1988 to 2010. It is obvious that the index captures some fluctuations in sentiment. In the early 2000s, owing to the Internet bubble, investor sentiment exploded and reached the highest value. Around

[1] Also known as cash return or earnings before income tax, depreciation, depletion, and amortization (EBITDDA).

[2] Refer to Baker and Wurgler (2006) for more details about the formation of the orthogonalized sentiment index.

Table 1.—Descriptive statistics of the quarterly returns for timberland assets, sentiment index and control variables from 1988 to 2010.[a]

	Mean	Median	Max.	Min.	SD
NTI	1.322	0.870	8.760	−2.940	1.695
NTF	1.131	0.705	7.930	−1.990	1.495
SENT	0.047	−0.055	2.260	−0.830	0.515
MKT	2.781	3.735	21.650	−22.090	8.376
SMB	0.843	0.205	19.100	−10.830	5.463
HML	0.603	0.270	23.850	−32.010	7.594
RF	0.980	1.120	2.190	0.000	0.559
TERM	1.816	1.855	3.700	−0.450	1.167
DEF	2.922	2.690	9.350	1.69	1.281

[a] NTI and NTF stand for the NCREIF Timberland Index and Timberland Fund and Separate Account Index. Logarithm is taken for the return data. SENT is the quarterly orthogonalized investor sentiment index formed by Baker and Wurgler (2006). MKT is the market return. SMB and HML are the size and value factors. The last three variables are the 1-month Treasury bill rate, term spread, and default spread, respectively.

2008 to 2009, because of the subprime mortgage crisis, people lost their confidence about the market. Therefore, their sentiment dropped from positive to negative.

Control variables

Following the suggestion of Brown and Cliff (2005), in order to control the information that the sentiment index may contain about the rational reflection of the market, risk factors that are used to predict the future performance are considered. These control variables are motivated by the previous asset pricing literature. Market return (MKT) is a risk factor used in the capital asset pricing model (Sharpe 1964, Lintner 1965). It is approximated by the value-weighted returns on all NYSE, American Stock Exchange, and National Association of Securities Dealers Automated Quotations stocks and comes from the Center for Research in Security Prices (CRSP). The size and value factors approximated by the Fama-French factors small minus big (SMB) and high minus low (HML) are considered as significant risk factors and included in the Fama-French three-factor model (Fama and French 1993). They are constructed using value-weighted portfolios formed by size and book-to-market ratio and are obtained from French (2012). Other control variables include risk-free rate, term spread, and default spread. Risk-free rate is approximated by the 1-month Treasury bill rate (Campbell 1991, Hodrick 1992), which is obtained from the CRSP. Term spread (TERM) is the yield difference between the 10-year Treasury bond and the 3-month Treasury bill (Fama and French 1989). Default spread (DEF) is the yield difference between the AAA bond rate and BAA bond rate (Keim and Stambaugh 1986, Fama 1990). These data are from the H.15 database of the Federal Reserve Board. In summary, quarterly data ranging from 1988 to 2010 are used. The descriptive statistics of the data and the correlation matrix of the sentiment index and control variables are reported in Tables 1 and 2, respectively.

Empirical Results

Results of short-term return predictability

Table 3 presents the result from the VAR model, which shows the interactions between the sentiment and timberland investment returns in the short run. The number of lags are determined by the AIC, HQ, and SC. AIC and HQ suggest $p = 8$, while SC suggests $p = 1$. For parsimonious purposes, we stick to a smaller order model. Therefore, a lag of one is chosen. This table only lists the estimation results for the timberland investment returns and sentiment index. From the estimation results in Table 3A, we find that the

Table 2.—Correlation matrix of the quarterly orthogonalized sentiment index and control variables.[a]

	SENT	MKT	SMB	HML	RF	TERM	DEF
SENT	1.000	−0.265	0.047	0.191	0.129	−0.274	−0.254
MKT	−0.265	1.000	0.418	−0.100	0.063	0.025	0.065
SMB	0.047	0.418	1.000	0.068	−0.317	0.338	0.131
HML	0.191	−0.100	0.068	1.000	−0.135	0.153	0.085
RF	0.129	0.063	−0.317	−0.135	1.000	−0.684	−0.436
TERM	−0.274	0.025	0.338	0.153	−0.684	1.000	0.455
DEF	−0.254	0.065	0.131	0.085	−0.436	0.455	1.000

[a] SENT is the quarterly orthogonalized investor sentiment index formed by Baker and Wurgler (2006). MKT is the market return. SMB and HML are the size and value factors. The last three variables are the 1-month Treasury bill rate, term spread, and default spread, respectively.

Table 3.—Short-term return predictability of investor sentiment to the NTI and the NTF with control variables from 1988 to 2010.[a]

		Independent variables	
Dependent variable	Lag	NTI	SENT
A. Short-term results for NTI			
NTI	1	0.012	0.005
SENT	1	−0.847*	0.913***
MKT	1	−0.004	0.005
SMB	1	0.033	−0.001
HML	1	0.011	0.000
RF	1	1.760***	−0.039
TS	1	0.407*	−0.061*
DEF	1	−0.071	0.015
Constant		−0.782	0.089
F stat.		2.807	55.040
P value		0.008	0.000
R^2		0.215	0.843
		Independent variables	
		NTF	SENT
B. Short-term results for NTF			
NTF	1	−0.207*	0.005
SENT	1	−0.583*	0.912***
MKT	1	−0.010	0.005
SMB	1	0.027	−0.001
HML	1	−0.010	0.000
RF	1	1.557***	−0.038
TS	1	0.406*	−0.061*
DEF	1	−0.116	0.015
Constant		−0.527	0.088
F stat.		2.704	55.030
P value		0.011	0.000
R^2		0.209	0.843

[a] This table only presents the estimation results for the NTI, NTF, and sentiment index. *, **, and *** represent significance at 10, 5, and 1 percent level, respectively. See Tables 1 and 2 for definitions of abbreviations.

Table 4.—Long-term return predictability of investor sentiment to the NTI and the NTF with control variables from 1988 to 2010.[a]

	1 yr	2 yr	3 yr	5 yr
A. Long-term regression coefficients for the NTI				
Intercept	−0.908	−0.832	−0.924	−1.505***
SENT	−0.633**	−0.775***	−0.686***	−0.300**
MARKET	0.019*	0.018**	−0.002	−0.011**
SMB	−0.022	−0.005	0.003	0.012
HML	0.013	0.029***	0.023**	0.011*
RF	1.411	1.036**	0.997**	0.948***
TERM	0.506	0.364**	0.356**	0.306***
DEF	−0.041	0.159	0.219	0.466***
F stat.	10.380	23.190	31.450	45.350
P value	0.000	0.000	0.000	0.000
R^2	0.476	0.681	0.754	0.832
B. Long-term regression coefficients for the NTF				
Intercept	−0.625	−0.437	−0.493	−0.976
SENT	−0.372	−0.569***	−0.512***	−0.217**
MARKET	0.016	0.018**	0.000	−0.007
SMB	−0.017	−0.005	0.002	0.008
HML	0.006	0.024***	0.016**	0.008***
RF	1.150	0.778**	0.742**	0.727***
TERM	0.430	0.267**	0.285**	0.244***
DEF	−0.065	0.106	0.139	0.335***
F stat.	8.741	21.120	31.790	52.010
P value	0.000	0.000	0.000	0.000
R^2	0.433	0.661	0.755	0.851

[a] Significance levels are adjusted by the Newey-West standard errors. *, **, and *** represent significance at 10, 5, and 1 percent level, respectively. See Tables 1 and 2 for definitions of abbreviations.

one-lagged investor sentiment index is an important factor that predicts the future returns of the NTI. The coefficient on the sentiment index is negative and significant at the 10 percent level. Although control variables such as the risk-free rate and term spread also show significance to the future timberland investment returns, they do not affect the significance of the sentiment index. This result confirms the trueness of our alternative hypothesis and suggests that overreactions caused by current optimism would increase the asset price and lower the subsequent one-quarter future returns. The R^2 indicates that by using the lagged variables, 21.5 percent of the total variation in the timberland investment returns are explained. Moreover, based on the *F* test result, the VAR(1) system is a valid model for testing the predictability of sentiment. However, there is no evidence that timberland investment predicts the sentiment, but the sentiment predicts itself. Similar results for the NTF are shown in Table 3B, which confirms that the current sentiment significantly negatively predicts the future timberland investment returns in the short run.

Results of long-term return predictability

To examine the long-term predictability of investor sentiment on timberland investment returns, the *k* period future return is regressed on the sentiment index and control variables. The results of the long-term return predictability with horizons of 1, 2, 3, and 5 years are presented in Table 4. The *k* period future return is calculated as the arithmetic average of the log returns. Tables 4A and 4B represent the coefficient estimates of the sentiment index and control variables. For all regressions, the dependent variables are the *k* period future returns of the timberland assets. The sentiment index and all the control variables considered in the short-term return predictability section are included in the regressions as independent variables. The correlations among the sentiment index and control variables, which are reported in Table 2, are relatively small. Therefore, multicollinearity is not a concern for the regression model that we fit.

Table 5.—Economic magnitude of sentiment in the long-term regressions.[a]

	SD	1 yr	2 yr	3 yr	5 yr
A. Economic magnitude of sentiment for the NTI					
SENT	0.515	−1.305	−3.195	−4.242	−3.092
MARKET	8.376	0.637	1.206	−0.201	−1.843
SMB	5.463	−0.481	−0.219	0.197	1.311
HML	7.594	0.395	1.762	2.096	1.671
RF	0.559	3.154	4.632	6.686	10.596
TERM	1.167	2.363	3.399	4.987	7.144
DEF	1.281	−0.210	1.630	3.367	11.942
B. Economic magnitude of sentiment for the NTF					
SENT	0.515	−0.767	−2.346	−3.166	−2.237
MARKET	8.376	0.536	1.206	0.000	−1.173
SMB	5.463	−0.371	−0.219	0.131	0.874
HML	7.594	0.182	1.458	1.458	1.215
RF	0.559	2.571	3.478	4.976	8.126
TERM	1.167	2.008	2.493	3.992	5.696
DEF	1.281	−0.333	1.087	2.137	8.585

[a] See Tables 1 and 2 for definitions of abbreviations.

As predicted by the alternative hypothesis, the results from Table 4A show that the sensitivity coefficients of the sentiment index are universally negative for all horizons considered, ranging from –0.300 to –0.775. The significance levels are determined by the Newey-West *t* statistics, which are calculated as the ratio between the coefficient estimates and the Newey-West standard errors with lags of 24. The test statistics show that the current investor sentiment significantly predicts future returns of the NTI over the next 1 to 5 years (5% level for the 1- and 5-year horizons and 1% level for the 2- and 3-year horizons).[3] Besides the sentiment factor, the market return, value effect, risk-free rate, term spread, and default spread are also significant factors that predict the future returns at a certain point of time.

Table 4B presents the long-run regression results of the NTF. Similar to the results of the NTI, negative coefficient estimates on the sentiment index are obtained. Comparing these results with those in Table 4A, current investor sentiment only predicts the 2- to 5-year future returns of the NTF significantly with values of –0.569, –0.512, and –0.217. In addition, control variables such as the value effect, risk-free rate, term spread, and default spread are significant in the long-term regression for the 2- to 5-year horizons.

The economic magnitude of the coefficients on sentiment is reported in Table 5. The magnitudes are taken by the coefficients on the sentiment index and control variables

[3] Note that the alternative test is a one-sided test; therefore, the critical values of the *t* statistics for the 90, 95, and 99 percent confidence intervals are 1.282, 1.645, and 2.326, respectively.

Table 6.—Performance of the NTI and the NTF in low- and high-sentiment periods from 1988 to 2010.

	Variance	*F* stat.	*P* value	Mean	Welch's *t* stat.	Welch's *P* value	No. of obs.
				A. NTI returns			
Low sentiment	22.252	2.071	0.021	3.507	−0.951	0.344	53
High sentiment	10.749			2.714			39
				B. NTF returns			
Low sentiment	16.689	1.901	0.040	2.903	−0.651	0.517	53
High sentiment	8.779			2.424			39

multiplied by the horizon and the standard deviation of each dependent variable. The standard deviations of sentiment and control variables are reported in the SD column. The values of magnitudes indicate the effect of one standard deviation change of the sentiment index on timberland investment returns. For example, with one standard deviation increase in the current investor sentiment, NTI will decrease by 1.305, 3.195, 4.242 percent per quarter in the first 3 years and decrease by 3.092 percent after 5 years. For both the NTI and the NTF, we obtain an increasing trend of the economic magnitudes in the first 3 years, and the magnitudes decrease thereafter.

Asset performance in low- and high-sentiment periods

In order to study the performance of timberland assets in different sentiment periods, we compare the average returns of the NTI and NTF in low- and high-sentiment periods as well as their variances. In this study, sentiment is defined as low when the values of the sentiment index are below zero and high when the values are above zero. The average returns, variances, numbers of observations, as well as the comparison results are reported in Table 6. Owing to the different numbers of observations in two samples, the Welch's *t* test is used to compare the sample means.

The results in Table 6 show that during the whole sample period from 1988 to 2010, there are 53 low-sentiment quarters and 39 high-sentiment quarters. Table 6A presents the performance of the NTI in each sentiment period. The variances in low- and high-sentiment periods are 22.252 and 10.749, which are significantly different based on the *F* test. With higher variance, returns in low-sentiment periods are more volatile than in high-sentiment periods. The average returns are 3.507 and 2.714 percent during low- and high-sentiment periods, respectively. However, the Welch's *t* test indicates that the average returns of the NTI in low- and high-sentiment periods are not significantly different. Similar results for the NTF are obtained, which are shown in Table 6B. The result confirms the previous finding that timberland investment earns stable long-term returns.

Robustness test

The long-run predicting power of the sentiment index is examined using the overlapping long-run timberland investment returns. In the meantime, investment sentiment index is found to be persistent. Some studies have argued that because of the persistence of the predictive variables and the overlapping observations, the OLS method may provide biased coefficient estimation (Hansen and Hodrick 1980, Stambaugh 1999). To test the robustness of the long-run regression results, the moving block bootstrap (MBB) method, as suggested by Schmeling (2009), is used. The data are split into $n - b + 1$ overlapping blocks, with n as the sample size and b as the block length. In this study, we set the block length to be 5. We then bootstrapped n/b (an integer is chosen) blocks from the $n - b + 1$ blocks randomly with replacement to generate 10,000 new time series samples. For each sample, we run the long-run regression and estimate the coefficients. For the results reported, the coefficient estimates are averaged among the 10,000 regressions results, and the standard deviations of the coefficients are also reported. From Table 7 we can see that for both the NTI and NTF, negative coefficients on the sentiment index are obtained for all the long-run horizons considered. The values of the coefficients estimated by the MBB method are almost the same as the ones from the OLS method. In addition, the standard deviations of the coefficient estimates are relatively small, indicating the accuracy of the estimates from the bootstrap samples. This result confirms that our results from the OLS are unbiased and robust.

Discussion and Conclusions

The debate about the effect of investor sentiment on asset pricing has been going on in financial economics for a long time. In this study, we use the orthogonalized sentiment index formed by Baker and Wurgler (2006) to examine the effect of investor sentiment on private-equity timberland investment returns in the short and long runs. The results show that current sentiment is an important factor that determines the one-quarter future returns of both the NTI and the NTF after controlling for other market variables. Moreover, the significant effect of the current sentiment persists over the next 1 to 5 years. Comparisons of the variances and average returns between low- and high-sentiment periods indicate that different sentiment drives different variances but not different average returns for both the NTI and NTF.

The empirical evidence of this study shows that investor sentiment significantly predicts timberland investment returns in the short run. This may be because the mispricing by irrational behaviors is not eliminated by the arbitrage forces in a short time. The persistent negative effects of the investor sentiment on the timberland investment returns indicate that current optimism about the stock market leads to an overvaluation of the timberland market over the next few years and vice versa. Accordingly, current high sentiment is an indicator of low cumulative long-run returns as the market price reverts to its intrinsic value. This implies that the irrationality in investors is capable of predicting the returns of timberland assets. Therefore, the importance of sentiment in the asset valuation model cannot be ignored.

Similar average timberland investment returns in low- and high-sentiment periods indicate that returns of timberland

Table 7.—Robustness test of long-run predicting power of sentiment index on timberland investment returns.

	Coef. (SD)[a]			
	1 yr	2 yr	3 yr	5 yr
	A. Long-run test for the NTI			
Intercept	−1.013 (1.075)	−0.561 (0.756)	−0.810 (0.628)	−1.394 (0.419)
SENT	−0.460 (0.435)	−0.785 (0.233)	−0.682 (0.184)	−0.335 (0.159)
MKT	0.025 (0.013)	0.013 (0.009)	−0.002 (0.008)	−0.010 (0.007)
SMB	−0.028 (0.018)	−0.004 (0.012)	0.002 (0.012)	0.011 (0.010)
HML	0.015 (0.012)	0.025 (0.010)	0.018 (0.010)	0.008 (0.009)
RF	1.135 (0.546)	0.901 (0.359)	0.909 (0.307)	0.898 (0.189)
TS	0.429 (0.232)	0.329 (0.146)	0.335 (0.103)	0.309 (0.061)
DEF	0.163 (0.280)	0.142 (0.162)	0.227 (0.118)	0.430 (0.101)
	B. Long-run test for NTF			
Intercept	−0.766 (0.858)	−0.204 (0.561)	−0.397 (0.467)	−0.878 (0.286)
SENT	−0.220 (0.363)	−0.583 (0.171)	−0.506 (0.131)	−0.246 (0.116)
MKT	0.020 (0.011)	0.012 (0.008)	−0.001 (0.005)	−0.006 (0.005)
SMB	−0.021 (0.015)	−0.003 (0.010)	0.001 (0.008)	0.007 (0.007)
HML	0.008 (0.009)	0.020 (0.008)	0.012 (0.007)	0.006 (0.006)
RF	0.939 (0.455)	0.664 (0.273)	0.669 (0.225)	0.686 (0.128)
TS	0.371 (0.183)	0.239 (0.109)	0.265 (0.079)	0.243 (0.041)
DEF	0.116 (0.240)	0.093 (0.122)	0.149 (0.089)	0.308 (0.070)

[a] Coef and SD stand for the mean values and standard deviations of the coefficients from the 10,000 simulated samples. See Tables 1 and 2 for definitions of abbreviations.

investment are relatively stable with respect to the investor sentiment. This can be explained by the unique return drivers of timberland investment: biological growth, timber price change, and land value appreciation. Among the three, biological growth contributes most to the total timberland returns and is independent of the financial condition (Mei et al. 2013). Therefore, this result further confirms that timberland investments are able to earn stable long-term returns and are good candidates of portfolio diversifiers.

Previous empirical studies showed that during economic downturns, investors check their portfolios or stocks less frequently than during economic booms. Hence, variances of returns are larger during high-sentiment periods than during low-sentiment periods. However, we obtain a contrasting result for timberland investment. One possible explanation is that when people are optimistic about the market, they tend to invest more in traditional financial markets, whereas during economic recessions, timberland assets, which have lower risks and more stable returns, become more attractive to investors.

It is worth mentioning that results from this study do not necessarily imply a profitable trading strategy. It is well known that the NTI and the NTF represent private-equity timberland investment returns by a large number of institutional investors and wealthy families in a fiduciary environment. As such, timberland transactions in the private market usually take months or even years to complete. Hence, the illiquidity of privately placed timberland assets may prevent any investment timing arbitrage opportunities implied by the investor sentiment index.

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