



## **The Effect of Investor Sentiment on Betting Against Beta: A Structural Equations Modeling Approach Towards Beta Anomaly**

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### **ABSTRACT**

Beta anomaly is one of the greatest anomalies in finance literature as capital asset pricing model (CAPM) conveys a positive relationship between the beta of a stock and future returns; however, empirical studies do not document this proposition. Branded as betting against beta (BAB), this conundrum is known as a controversial subject. Drawing on literature the authors propose new multi-factor models to develop our understanding of BAB using investor sentiment as well as structural equation modeling methodology to gauge the models in the presence of the top-down approach. Results indicate that investor sentiment provides a good explanation of the BAB. Limitation and future research directions are presented at the end of paper.

**Keywords:** Behavioral Finance, Investor Sentiment, Betting Against Beta Factor

**JEL Classifications:** G02, G10

### **1. INTRODUCTION**

For a long time traditional finance theories had been deemed to be unique before behavioral finance emerged to complement and enrich them. In this framework, the behavior of retail or individual investors is realized systematically correlated (Kumar and Lee, 2006) and labeled as investor sentiment. Measuring investor sentiment in the stock market has been one of the striking issues in finance literature, so many investigators (e.g., Baker and Wurgler, 2006; Canbaş and Kandir, 2009; Wang and Chen, 2012; Bathia and Bredin, 2013; Kim and Park, 2015) have been trying to estimate it since behavioral finance came to the fore as a novel framework to deal with imperfections of investors decision making and the anomalies of financial market. For more details; see Thaler (2005) and Shefrin (2010).

Branded as betting against beta (BAB henceforth), beta anomaly has been a controversial subject recently and labeled as the most extreme anomaly in finance (Baker et al., 2011). This anomaly hails from empirical studies where low-beta stocks eventuate in higher return and high-beta stocks result in lower return than

expected returns. Frazzini and Pederson (2014), construct BAB factor, a portfolio that holds low-beta assets and leverages it to a beta of one, also, shorts high-beta assets and de-leverages it to a beta of one. They find that BAB factors have a positive average return increasing in the spread among betas between high- and low-beta securities. Fortunately, explanations for the BAB may also have behavioral roots due to these very reasons that: There is important market frictions like leverage constraints (Jensen et al., 1972) and benchmarking (Baker et al., 2011) that make high-beta stocks very interesting. Moreover, psychology- notably lottery demand (Bali et al., 2014) - reasoning is of a strong explanatory power in exploring these types of issues.

Considering behavioral theory as a critical aspect of finance, this research is being directed to investigate the role of investor sentiment in beta anomaly in the stock market based on structural equations modeling (SEM) in order to cast light on the relationship between BAB factors return and investor sentiment. Therefore, this study tries to answer this question that if the investor sentiment influences BAB phenomenon. To find an explanation of this impact

in the stock market, researchers employ an index of investor sentiment (Baker and Wurgler, 2007) to utilize it as an explanatory variable in four adopted multi-factor regression models for BAB factor returns (Frazzini and Pedersen, 2014) using US markets data covering 1965-2012.

The paper is organized as follows: Section 2 provides reviews germane to our study. Section 3 explains our methodology and SEM-partial least squares (PLS) model. Section 4 shows results and examines the validity. Section 5 concludes the paper.

## 2. LITERATURE REVIEW

### 2.1. Beta Anomaly

Jensen et al. (1972) prove a negative abnormal return of portfolios consisting of high-beta stocks in CAPM. They demonstrate that portfolios of high-beta stocks glean lower returns than implied by the CAPM, whilst portfolios of low-beta stocks earn higher returns. This beta anomaly is also investigated in Blum and Friend (1973), Fama and Macbeth (1973), Fama and French (1992; 1993), and Baker et al. (2011). By extending these studies, Fama and French (1993; 2006) show that the relationship between beta and return becomes even flatter by controlling size and book-to-market characteristics (Three-factor model). This investigation is proceeded with an additional variable for momentum included into the model (Four-factor model) by Carhart (1997). Pástor and Pietro (2003) suggest a model containing all stated factors in addition to two factors for liquidity and profitability (six-factor model). Declining in alpha, all these efforts lead to perennial existence of the beta anomaly in stock market.

In a seminal recent context, Frazzini and Pederson (2014), corroborate the underperformance of high-beta stocks over a long sample period from 1926 to 2012 and develop a BAB strategy. They also display that BAB effect exists not only in the U.S. stock market but also in 20 international equity markets besides other asset classes. Furthermore, they construct a BAB factor that goes long low-beta stocks while shorting high-beta stocks. By adjusting the portfolio, deleveraging high-beta and leveraging low-beta, to have a beta of one, they constitute BAB factor market neutral. Leveraging up the low-beta stocks to capitalize investors attractive risk-return feature is the idea behind BAB factor. Simultaneously, Novy-Marx (2014) reveals much the same findings by exploiting beta and total volatility sorted portfolios in the U.S. stock market covering 1968-2013. According to his findings returns are flat across volatility and beta quintiles. Similar studies on BAB were presented, for example, Buchner and Wagner (2016), Auer and Schuhmacher (2015).

### 2.2. Investor Sentiment

According to behavioral finance theory, a mispricing is the result of both a sentiment-induced uninformed demand shock and a limit on arbitrage (Baker and Wurgler, 2006). In the context of beta anomaly, specifically BAB, uninformed demand has been explained to be the result of psychological factors such as representativeness (Kaustia et al., 2009), overconfidence (Baker et al., 2011), (Kaustia and Perttula, 2012), (Miller, 1977), and lottery demand (Bali et al., 2014), (Kumar, 2009), (Li et al.,

2014). Furthermore, leverage constraints (Frazzini and Pedersen, 2014), (Blitz and Van vliet, 2007), and benchmarking (Baker et al., 2011), (Sensoy, 2009) provide important limit on arbitrage that are of an appreciable effect on beta anomaly. Famous context probing the return predictability of investor sentiment include Kaniel et al. (2008), Brown and Cliff (2004), and Dorn et al. (2008).

Baker and Wurgler (2006; 2007) show that young, small, distressed, extreme-growth, non-dividend paying, unprofitable, and volatile stocks are most affected by investor sentiment because these types of stocks are considered difficult to value and difficult to arbitrage.

To develop the literature presented so far, the aim of this context is to examine whether individual investor sentiment plays a part in the constitution of returns on BAB factor.

## 3. RESEARCH MODEL, METHODOLOGY AND DATA

In this research, four multi-factor regression models have been developed in order to increase our understanding of behavioral finance and beta anomaly relationship. Specifically, this study investigates the role of investor sentiment to explain BAB phenomenon. Along with excess return on market (CAPM), size, value (three-factor model), momentum (four-factor model), liquidity, and profitability (six-factor model), the authors added investor sentiment as an on-going issue in BAB factor returns. These are included into the models as shown in Figures 1-4. In these models we use:

- BAB factor returns that are monthly returns on a zero-cost portfolio and goes long in low beta stocks while shorting the high beta stocks. The nuances of BAB factor formation can be found in Frazzini and Pedersen (2014);
- Excess return on market, size, value, and momentum are the returns on zero-cost portfolios trying to emulate the underlying exposures to book-to-market, size, and momentum effects. More details in Fama and French (1993) and Carhart (1997);
- Liquidity contains the monthly returns on traded liquidity factor. The calculation can be find in Pastor and Stambaugh (2001);
- Profitability factor returns are from Pástor and Pietro (2003). The profitability factor goes long in profitable stocks while shorting the least profitable of stocks;
- And the investor sentiment data includes monthly time-series values of the sentiment index introduced in Baker and Wurgler (2006, 2007). Their sentiment index combines six investor-sentiment proxies to create one that captures the effects of all. More detailed analysis of the index composition and construction can be found in Baker and Wurgler (2006).

It must be noted that in the SEM models the rectangles are observed indicators that can be measured directly and act as indicators for underlying variables. The mere endogenous variable in all models is monthly return on BAB.

### 3.1. Prerequisite

To study BAB in the behavioral finance framework, before going any further, it must be clarified that high-beta stocks are both difficult to arbitrage and difficult to value. As stated earlier, small, newer, distressed, non-dividend, unprofitable, extreme growth and volatile stocks are hard to arbitrage and hard to value (Baker and Wurgler, 2007). Based on the literature, these characteristics exist in the stocks with high-beta (Novy-Marx, 2014; Bali et al., 2014; Frazzini and Pedersen, 2014; and Li et al., 2014); therefore, investigating BAB through the behavioral framework is rhetoric.

### 3.2. Investor Sentiment Approach

As a tenet of investment risks and future cash-flows, investor sentiment cannot be justified by general axioms; on the whole, there exist two approaches to deal with. Firstly, there is bottom-up approach based on investors prejudice and also biases such as conservatism, overconfidence, and representativeness. Secondly, the top-down and macroeconomic approach whose main focus is on the measurement of reduced-form, aggregate sentiment and traces its effects to market returns and individual stocks (Baker and Wurgler,

2007). Due to its advantage- the potential to encompass bubbles, crashes, and everyday patterns in stock prices in a simple, intuitive, and comprehensive manner- the investor sentiment approach adopted in this study is distinctly macroeconomic and top-down.

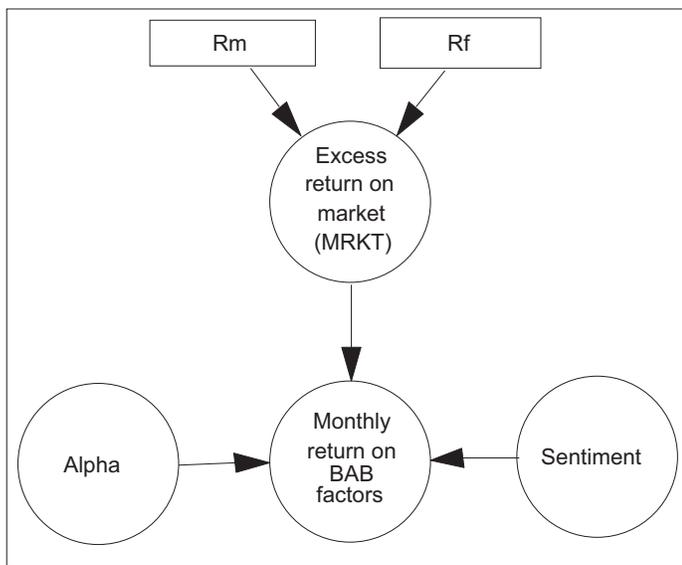
### 3.3. Structural Model

The present study applies structural equation modelling (SEM). SEM, as recommended, has numerous privileges over other methods (Gefen et al., 2011) particularly in terms of factor analysis. PLS method is employed to study the question of research. PLS has advantages compared to other methods like LISREL (Chin, 1998; Ringle et al., 2012) but the main reason for PLS to be chosen, is its exploratory power (Chin, 1998; Gefen and Straub, 2004) which is the nature of this paper as well. This method is also propitious for examining a newfound theory and model as it can be felicitous for exploratory and confirmatory research (Gefen et al., 2011).

### 3.4. Data Collection

To study the effect of investor sentiment on BAB returns, authors employed monthly BAB returns, excess market return, size, value, liquidity, momentum, profitability, and investor sentiment data for the period August 1965-January 2012. Of note is that, the data have a wider time horizon but researchers consider their overlap. Table 1 provides a detailed account of different data that were adopted.

Figure 1: Adopted capital asset pricing model in the presence of investor sentiment (Model 1)

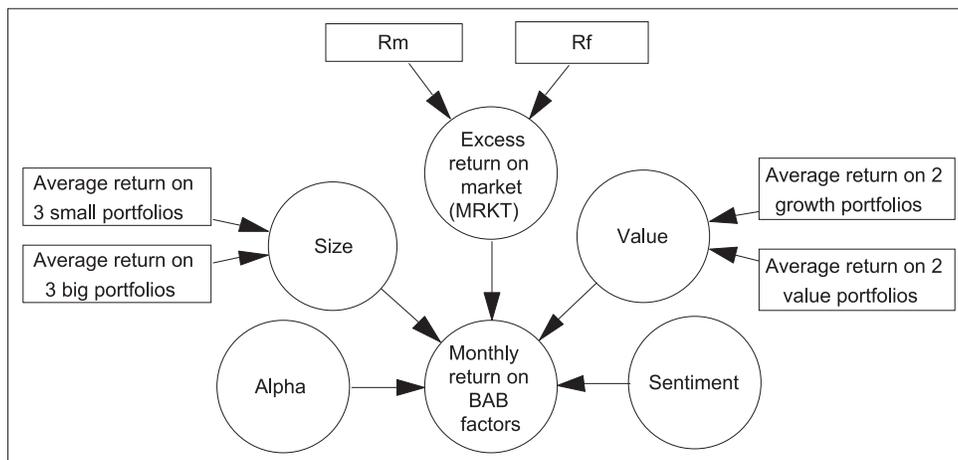


## 4. EMPIRICAL ANALYSIS

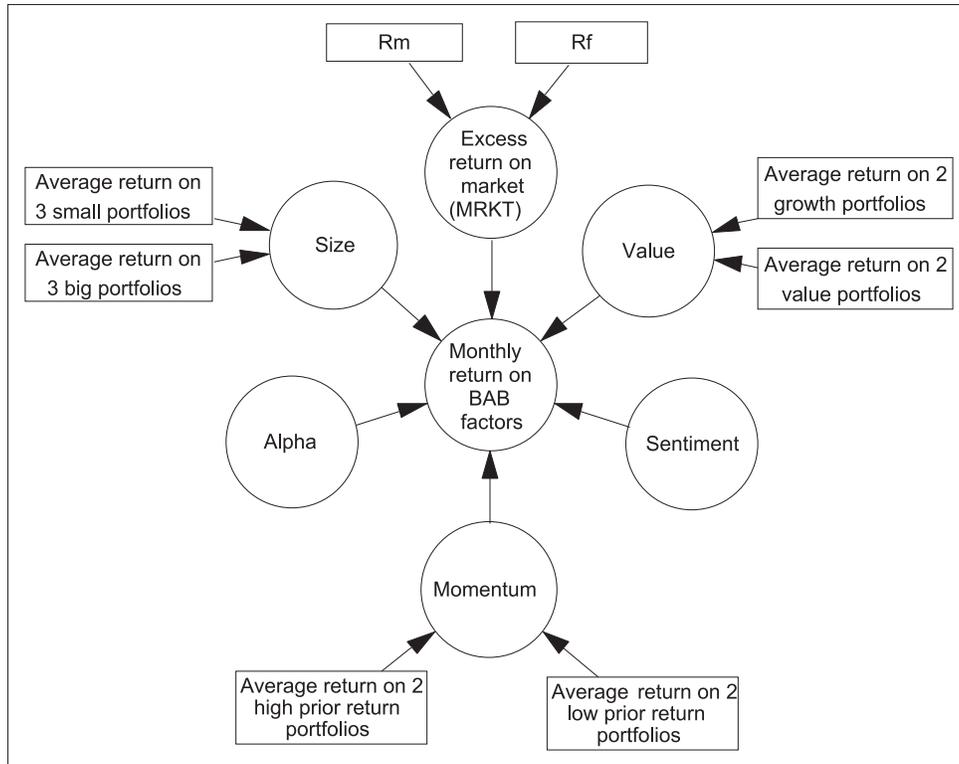
In this section, monthly returns on BAB is examined to find the investor sentiment role in explaining this phenomenon. To do this, four well-known multi-factor models in finance literature are adopted and developed by the researchers to show the explanatory power of investor sentiment and other factors on BAB returns.

Table 2 presents the estimation results from SmartPLS software at the 0.05 level. Moreover, the researchers performed bootstrapping to test the statistical significance of coefficients by means of t-tests. According to the results, all sentiment coefficients are positive and significant, meaning that higher level of investor sentiment predicts positive returns for BAB factors. Also, it can be seen that there is a negative size-return relationship in terms of BAB. The effect of size on monthly BAB return is similar in Models 1-3. The results

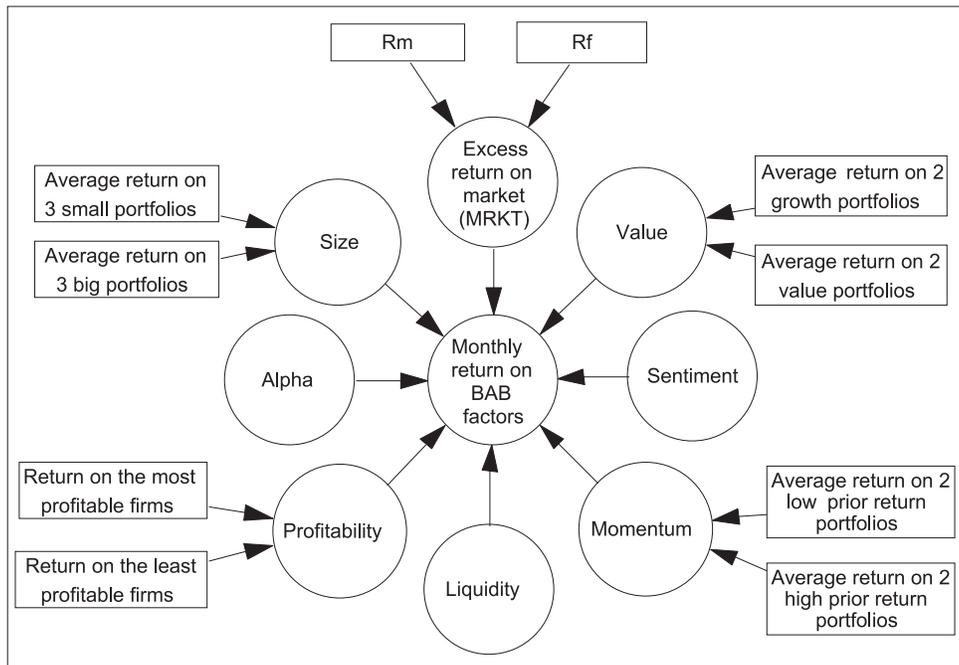
Figure 2: Adopted Fama-French model in the presence of investor sentiment (Model 2)



**Figure 3:** Adopted four-factor model in the presence of investor sentiment (Model 3)



**Figure 4:** Adopted six-factor model in the presence of investor sentiment (Model 4)



show that a one-standard deviation shock leads to a decrease in return on BAB by 0.01% over the next month. On the other hand, adding more variables leads to a fall in the sentiment coefficient and its statistical significance to some extent. Notably, value and momentum factors play a large part in explaining the BAB returns.

The model validity is assessed by  $R^2$  value (Chwelos et al., 2001). The result of  $R^2$  shows that almost 2% of the variance in the model 1 was accounted for by investor sentiment and excess return on

market. The results indicate that  $R^2$  has an ascending trend; it is 13% in model 2 and 20% in model 3. The  $R^2$  value for model 4 means that 25% of the variance in this model was accounted for by investor sentiment, excess return on market, size, value, momentum, liquidity, and profitability.

Further assessment was made to gauge the research validity, discriminant validity, to examine the extent to which a model is different from others (Wasko and Faraj, 2005). As it is presented

**Table 1: Data sources**

Source	Time horizon	Data
Lasse Pedersen's website	April 1929-March 2012	BAB factor returns
Kenneth French's website	July 1926-May 2016	Excess market return, size, value
Kenneth French's website	January 1927-May 2016	Momentum
Lubos Pastor's website	August 1962-December 2015	Liquidity
Robert Novy-Marx's website	July 1963-December 2012	Profitability
Jeffrey Wurgler's website	July 1965-September 2015	Investor sentiment

BAB: Betting against beta

**Table 2: Result of the PLS analysis**

Models	Alpha	MRKT	Sentiment	Size	Value	Momentum	Liquidity	P	Adjusted R <sup>2</sup>
Model 1	0.9 (6.46)	0.07 (1.93)	0.39*** (-2.64)						0.02
Model 2	0.73 (5.28)	0.05 (-1.38)	0.37*** (-2.79)	-0.01 (-0.23)	0.38 (-10.19)				0.13
Model 3	0.55 (-3.97)	0.06 (-2.36)	0.33*** (-2.53)	-0.01 (-0.22)	0.41 (-11.64)	0.24 (-6.47)			0.2
Model 4	0.44 (-3.11)	0.08 (-2.44)	0.26*** (-1.77)	-0.01 (-0.69)	0.57 (-10.89)	0.25 (-7.3)	0.08 (-1.43)	0.09 (-2.41)	0.25

The models include a factor for beginning of period sentiment (Sent). The beginning of period sentiment is the prior month's level of investor sentiment index from Baker and Wurgler (2007). The sentiment index is standardized; the mean and standard deviation are 0 and 1, respectively. T-statistics are reported in parenthesis. There are 530 observations for all models. \*\*\*P<0.1, PLS: Partial least squares

**Table 3: Square of correlation between factors**

Variables	BAB return	Liquidity	MRKT	Momentum	P	Sentiment	Size	Value
BAB return	0.97							
Liquidity	0.07	0.92						
MRKT	0.10	0.06	0.83					
Momentum	0.20	0.03	0.14	0.92				
Profitability	0.08	0.05	0.09	0.00	0.91			
Sentiment	0.19	0.24	0.27	0.12	0.17	0.75		
Size	0.08	0.04	0.32	0.03	0.06	0.09	0.63	
Value	0.37	0.02	0.32	0.10	0.33	0.05	0.20	0.91

Numbers in boldface are average variance extracted. Other numbers are the square of correlation, BAB: Betting against beta

in Table 3, all average variance extracted are greater and prove discriminant validity.

Considering the positive and statistically significant coefficients for investor sentiment in all the multifactor regressions, it seems that sentiment plays an important role in explaining the returns on BAB. Finally, the results provide evidence that investor sentiment influences the BAB.

## 5. CONCLUSION

This context investigates the new stream in finance literature. By utilizing behavioral finance, or better still investor sentiment, researchers try to offer better understanding of BAB phenomenon. In the present study, four accepted models borrowed and developed to explain investor sentiment as well as its influences on monthly returns on BAB factor. BAB factor is market neutral self-financing portfolio that goes long low-beta stocks while shortselling high-beta stocks. In this way, CAPM, Three-factor model (Fama and French, 1993), Four-factor model (Carhart, 1997), and six-factor model (Pastor and Stambaugh, 2001; Pástor and Pietro, 2003) were adopted and investor sentiment factor was added into the model for the period from August 1965 to January 2012. The results of empirical analysis, using SEM-PLS show the direct and statistically significant effect of investor sentiment on BAB returns. As a matter of fact, this finding gives some highlights into the study of beta anomaly and the effect of investor sentiment.

The main contribution of this research is in the exploiting of a behavioral framework to study and explain BAB phenomenon. While the results document the role of investor sentiment as an explanation of the BAB, there seems to be a dichotomy between explanations (e.g. investor sentiment and benchmarking). Trying to distinguish between them provides an interesting realm for future research.

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