How can we assess if markets are fairly valued?

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- Valuation is obviously central to most financial decisions
- The classical finance model - the rational, representative agent model fails to explain much of what we see in the markets- excess volatility - bubbles– crashes- persistent mispricing- illiquidity
- Behavioural Finance offers an understanding of a range of real world experiences
    - Agent based interaction effects-complexity
    - Propect theory- loss aversion
    - Knightian Uncertainty - as opposed to risk
    - Impact of sentiment- herding- on asset prices

http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=358995

http://www2.warwick.ac.uk/fac/soc/wbs/subjects/finance/faculty1/mark_s

Is the stock market over valued?

- Need to value fundamentals and growth

classic ratios- Price-Earnings relative to historical averages- trailing and forward estimates

- Macro economic approach– McGratten E. and E. Prescott, Federal Reserve Bank of Minneapolis Quarterly Review Vol. 24, No. 4, Fall 2000, pp. 20–40
- Tobin's Q- Andrew Smithers, Stephen Wright, Valuing Wall Street, McGraw-Hill (2000) - value of stock market to corporate net worth or market value of installed capital to replacement cost of capital
- We will take different approach - based on examining to what extent Sentiment - relative optimism or pessimism is present in the market.

- Classical finance rests on beliefs consistent with rational expectations, E_t, and most research has therefore has just focussed on determining the fundamental drivers of asset prices,x_{t+1},

$$p_t = E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} x_{t+1} \right]$$

- Whereas prices in the market are determined by market beliefs, E_t^m which may be driven by behavioural forces such as Sentiment, so loosely....

$$p_t = E_t^m \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} x_{t+1} \right] = E_t \left[\beta \frac{u'(c_{t+1})}{u'(c_t)} x_{t+1} \right] + \text{Sentiment}_t$$

This talk has the following objectives:-

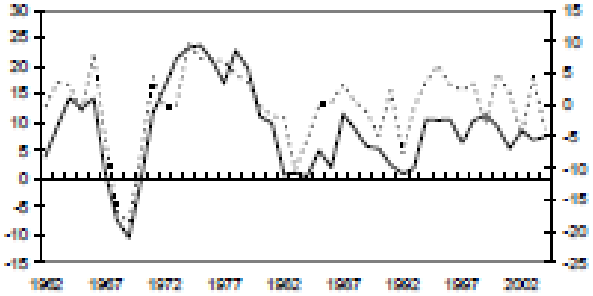
- To describe and estimate a new, *theoretically* motivated, measure of investor sentiment for the US and the UK, based on Risk Appetite,
- To examine the properties and relationship between the estimated UK and US sentiment indices and the returns on the FTSE100 and S&P500,
- To investigate the differences in the impact of sentiment on the cross section of equities in both countries
- and finally to examine when markets are "mispriced" due to sentiment

Risk Appetite

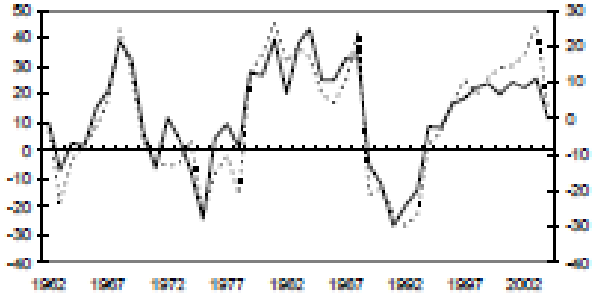
- Virtually all measures of Sentiment are *ad hoc* being constructed from empirical proxies with limited theoretical basis or surveys
- Baker and Wurgler (JoF 2006) for instance develop a measure for sentiment based on extracting the first principal component from 6 proxies

Trading volume as measured by NYSE turnover;
the dividend premium;
the closed-end fund discount;
the number and first-day returns on IPOs;
and the equity share in new issues

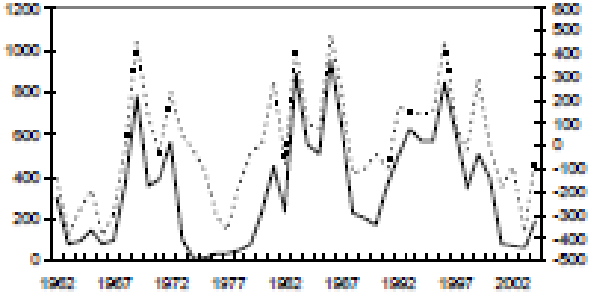
Panel A. Closed-end fund discount %



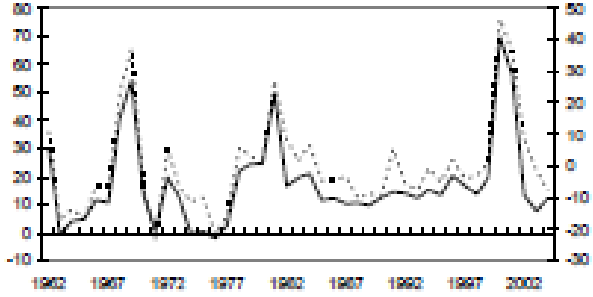
Panel B. Turnover %



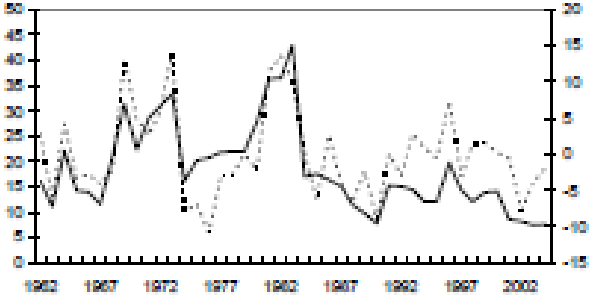
Panel C. Number of IPOs



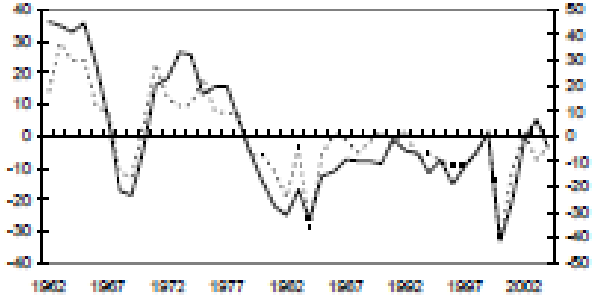
Panel D. Average first-day return



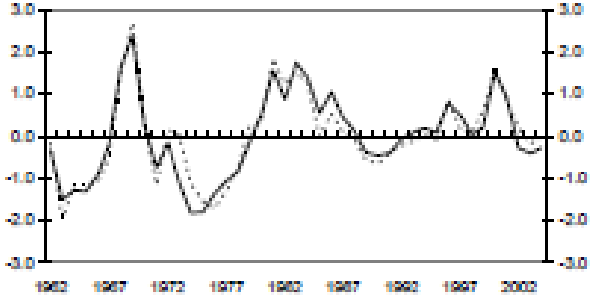
Panel E. Equity share in new issues



Panel F. Dividend premium



Panel E. Sentiment index (SENTIMENT)



- BW find that stocks of low capitalization, younger, unprofitable, high volatility, non-dividend paying, growth companies, or stocks of firms in financial distress will be disproportionately affected by sentiment.
- Do we find the same with our sentiment measure?
- Do we find the same for the UK?
- How is does sentiment differentially affect UK and US stocks and bonds?

- Instead of following the proxy approach we attempt to develop an empirical measure of sentiment which is firmly grounded in theory.
- Risk Appetite- is the willingness to bear risk - is often used interchangeably with Risk Aversion and Risk Premium - but each concept is distinct- we will use Risk Appetite or the inverse of the price of risk to measure Sentiment

- *Risk Appetite* depends on both the degree to which investors dislike the risk to future consumption (risk aversion) and the level of that risk which depends on macro conditions
- *Risk Aversion* can be thought to be (relatively) constant whereas Risk Appetite varies with the state of the market and the economy
- In bad times investors require higher expected excess returns to hold each unit of risk and risk appetite will be low- it is the inverse of the price of risk.

- When the price of risk is taken together with the quantity of risk in an asset then the risk premium is the expected return required to compensate investors for holding the asset.
- Following Gai and Vause (2006) and others we measure Risk Appetite based on the variation in the ratio of risk neutral to objective probabilities used by investors in evaluating the expected payoff of an asset in a way that is free of any assumption regarding the utility function.
- Critically our measure of sentiment is also based on the *entire* RN and objective distributions not just one moment such as the variance or skewness.

- Cochrane (2001) shows that in an efficient, rational fully informed market the current price of the asset p_t should equal the expected discounted value of its future payoffs

$$p_t = E_t(m_{t+1}x_{t+1}) \tag{1}$$

where m_{t+1} is the SDF- the marginal rate at which the investor is willing to substitute consumption at time $t+1$ for consumption at time t.

- This equation can be re-expressed in terms of gross returns R_{t+1}

$$1 = E_t(m_{t+1}R_{t+1}) \tag{2}$$

all assets have the same expected discounted returns in equilibrium of unity.

- which can be re-written as

$$1 = \underbrace{E_t(m_{t+1})E_t(R_{t+1})}_{\text{risk neutral part}} + \underbrace{cov(m_{t+1}R_{t+1})}_{\text{risk adjustment}} \tag{3}$$

- mean return required to hold asset if indifferent to risk and then adjustment for risk aversion
- Given the gross risk-free rate is given by

$$R^f_{t+1} = 1/E_t(m_{t+1})$$

we can rewrite this as

$$\underbrace{E_t(R_{t+1}) - R^f_{t+1}}_{\text{risk premium}} = -R^f_{t+1} cov(m_{t+1} R_{t+1}) \tag{4}$$

The risk premium is proportional to the covariance of the state contingent rate of return and the stochastic discount factor.-

- This risk premium can be further decomposed into the quantity of risk, β_i, in each asset , and the unit price of risk common to all assets λ_t

$$E_t(R_{t+1}) - R^f_{t+1} = -\underbrace{\frac{cov(m_{t+1} R_{t+1})}{var(m_{t+1})}}_{\beta_i} \underbrace{var(m_{t+1}) R^f_{t+1}}_{\lambda_t} \tag{5}$$

- The Price of Risk, λ_t, is the expected excess return investors require to hold each unit of risk
- Risk Appetite- the willingness to bear risk, is defined then as the inverse of the price of risk, so when risk appetite falls, larger expected excess returns are required to hold risky assets
- Risk Appetite, from (5), reflects the variation in the SDF and with power utility and log normal consumption growth the price of risk is

$$\lambda_t = \gamma \sigma^2_{c_{t+1}} \tag{6}$$

  where γ is coefficient of absolute risk aversion - so a rise in γ and $\sigma^2_{c_{t+1}}$ would imply a fall in risk appetite
- So macro factors more likely to change risk appetite than γ varying

- Asset prices can be determined using objective probabilities, π,

$$1 = E_t(m_{t+1}R_{t+1}) = \sum_{s=1}^{S} m_{t+1}(s)R_{t+1}(s)\pi_{t+1}(s) \qquad (7)$$

or in terms of risk neutral probabilities π^*

$$1 = E_t(m_{t+1})E^*(R_{t+1}) = \sum_{s=1}^{S} \frac{1}{R^f_{t+1}} R_{t+1}(s)\pi^*_{t+1}(s) \qquad (8)$$

The Price of Risk

- (7) and (8) imply

$$\frac{\pi^*_{t+1}(s)}{\pi_{t+1}(s)} = m_{t+1}(s) R^f_{t+1} \tag{9}$$

- The mean of the risk neutral distribution is $R^f_{t+1} = 1/E_t(m_{t+1})$ whereas the mean of the objective density is given by equation (2) and the difference between the two means is the risk premium
- So from definition of λ_t we have

$$\lambda_t = \frac{1}{R^f_{t+1}} var\left(\frac{\pi^*(s)}{\pi(s)}\right)$$

as a measure of the price of risk

Construction of Sentiment Indicies

With this theoretical background we proceed to construct the empirical measures in the following manner:

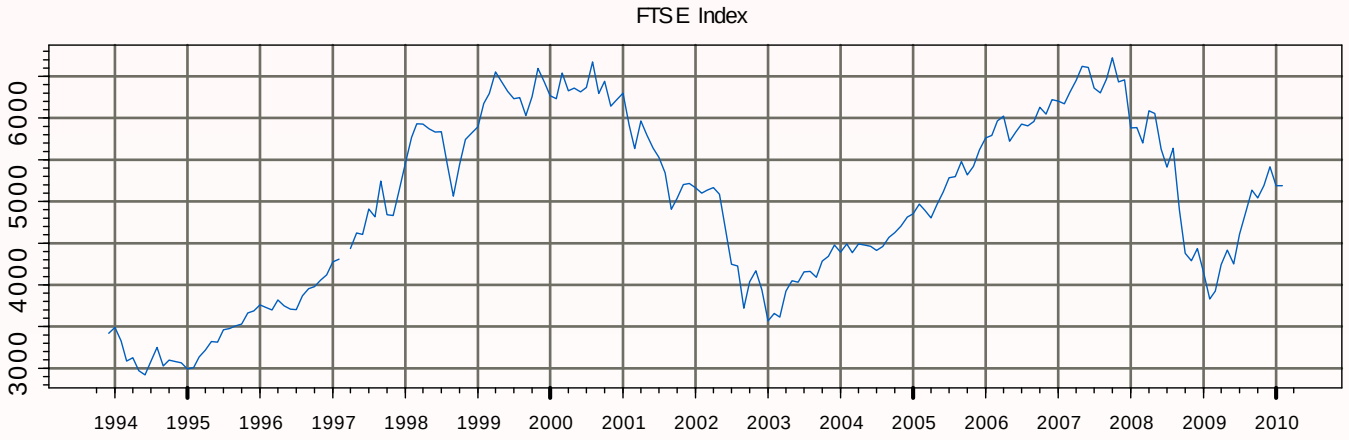
1. Compute the implied PDF's using standard methods from daily option prices using the most liquid constant maturity 3 month contracts
2. Compute 3 month daily returns and then we need to construct a 3 month ahead forecast of the realised density to compare with the implied PDF , which we achieve using quantile methods as opposed to a specific parametric assumption for the second moment, such as a GARCH model as used by the Bank of England
3. We model each quantile of the realised density separately by computing 500 quantiles ranging from 0.1% to 99.9% with a step of 0.2%. From this we compute the empirical distribution function for each day evaluated at 500 points

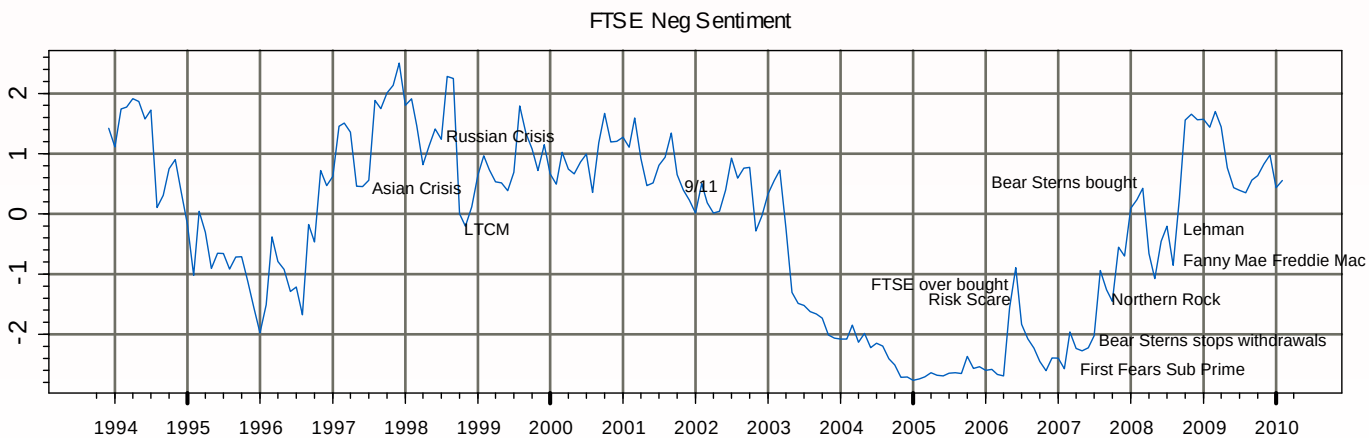
4 We then compute one step 3 month ahead forecasts of each quantile of the CDF using a simple AR(1) model. Thus we generate daily 3 month forecasts CDF using rolling regressions on 500 quantiles. We resolve the problem of quantile crossing by drawing 10000 random numbers from a uniform distribution onto each CDF, thus sampling directly from it. Then use cubic splines to fit the new CDF function.

5 From this CDF we can directly derive the PDF each day and proceed to compute the price of risk, λ_t as described on the previous slide.

- Our measure , which we label as Sentiment below, is in fact the Price of Risk so should be interpreted as **Negative Sentiment**

Sentiment on FTSE





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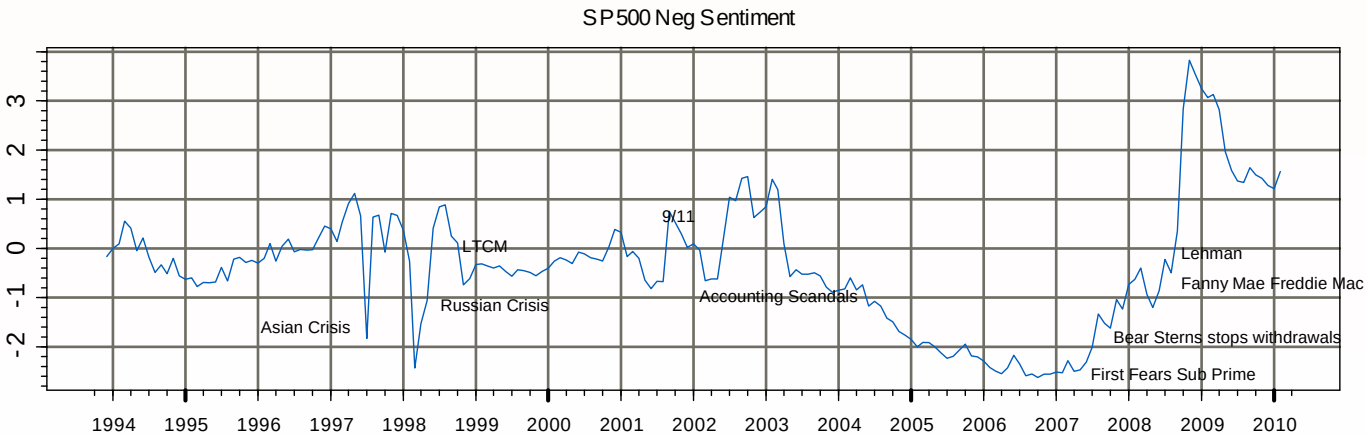
Sentiment on SP500



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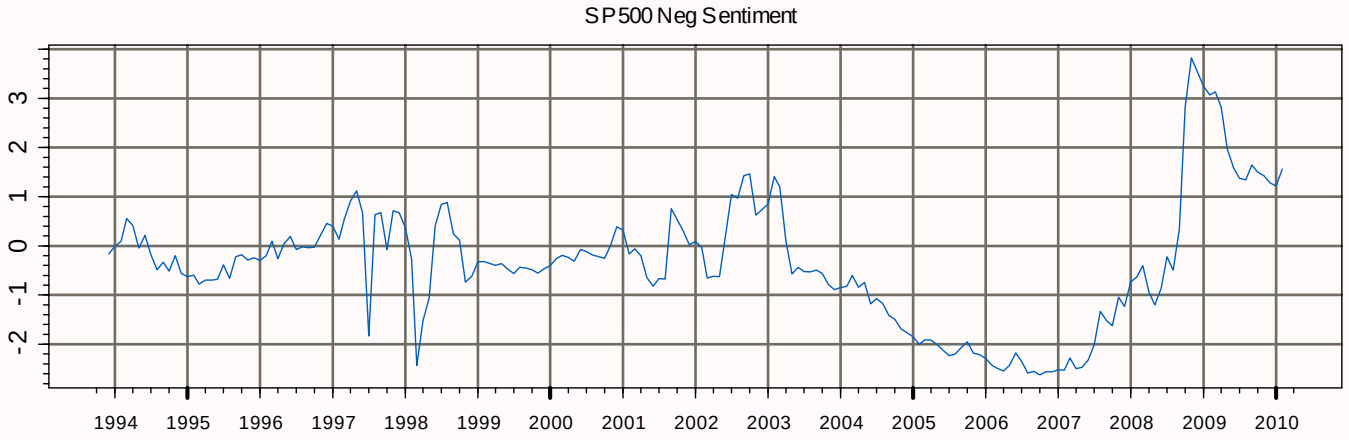
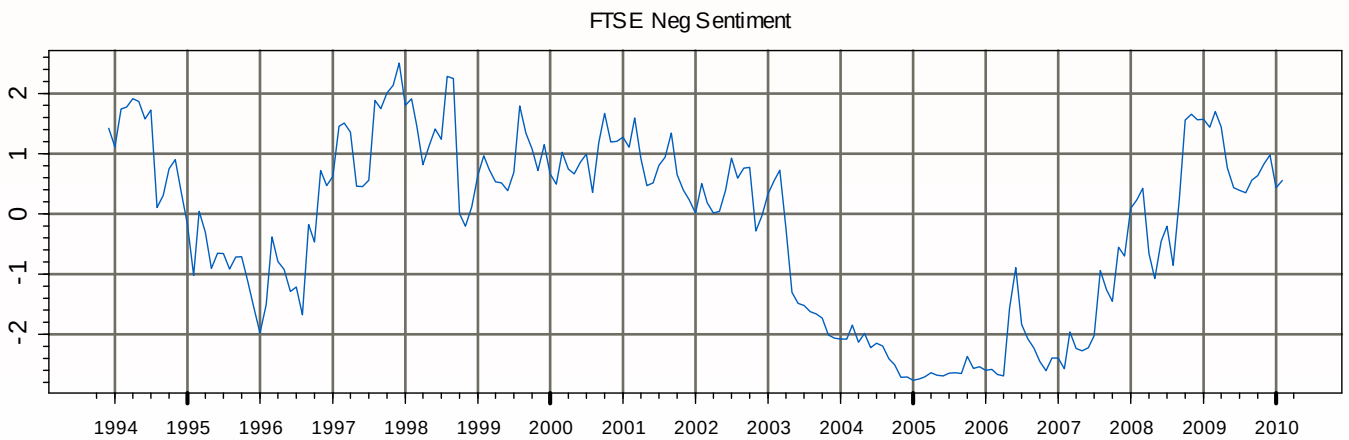
Sentiment in UK and US





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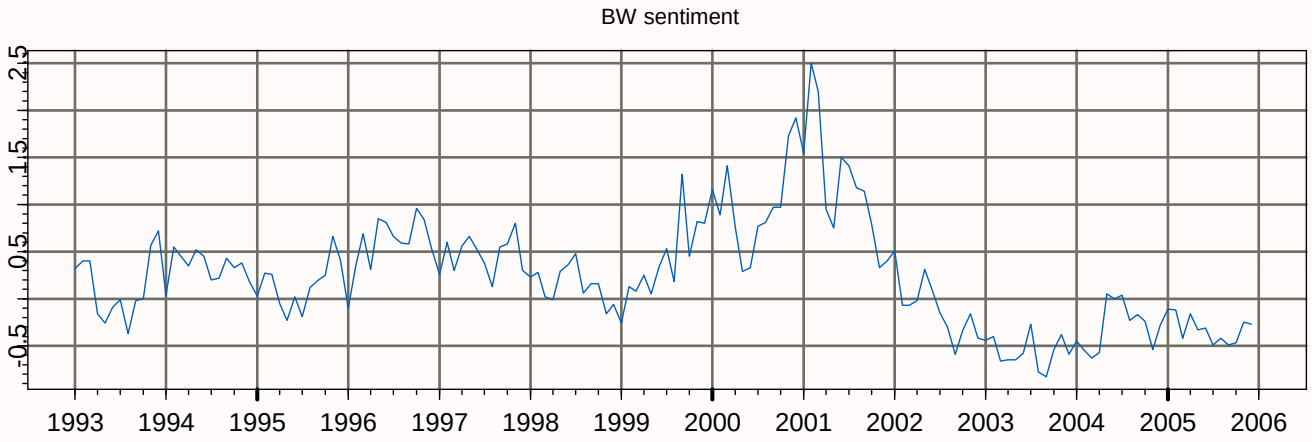
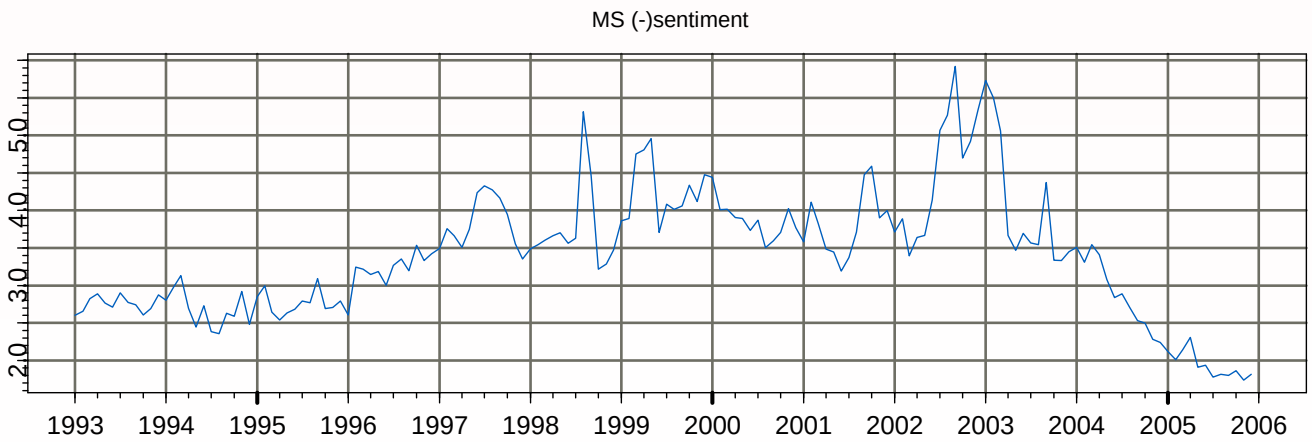
Comparison with Baker and Wurgler's proxy for sentiment





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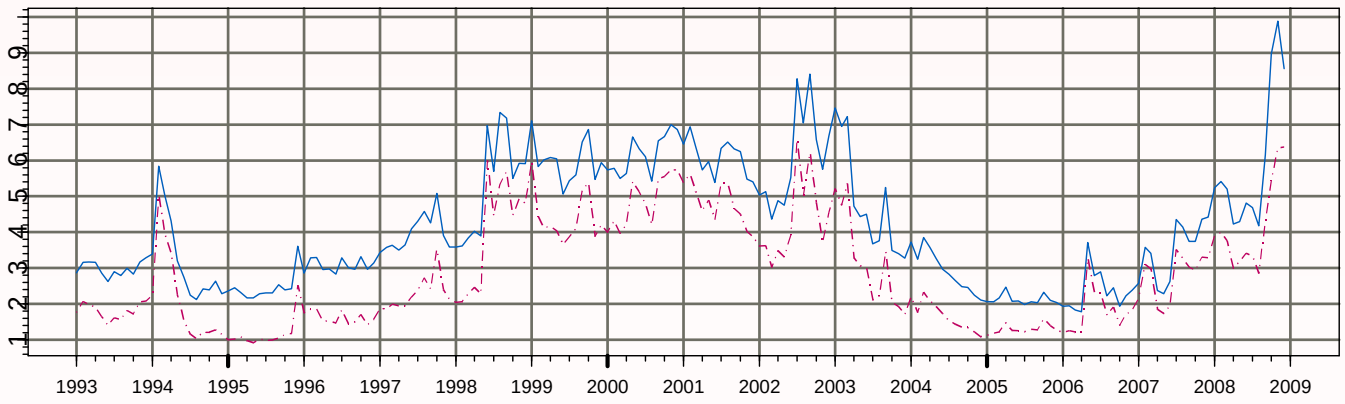
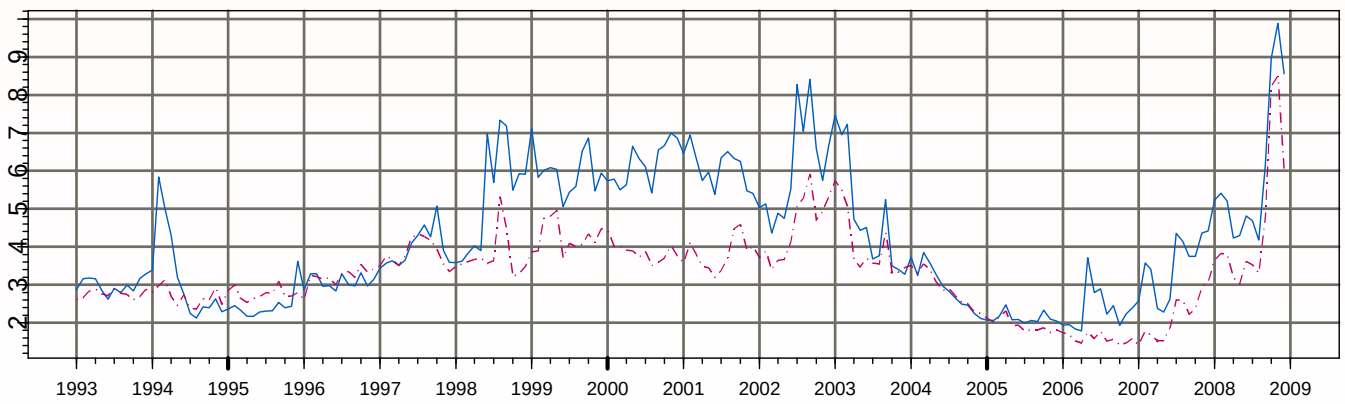
- The correlation between Baker and Wurgler's sentiment and our own is only 0.152
- The correlation between our UK sentiment and US sentiment indices is 0.71
- There is evidence for structural dynamics in Sentiment that is different to the market itself and at least for the US our sentiment measure appears to lead the market index

Local and International Sentiment

UK sentiment(dashed) and International sentiment (solid)



US sentiment(dashed) and International sentiment (solid)



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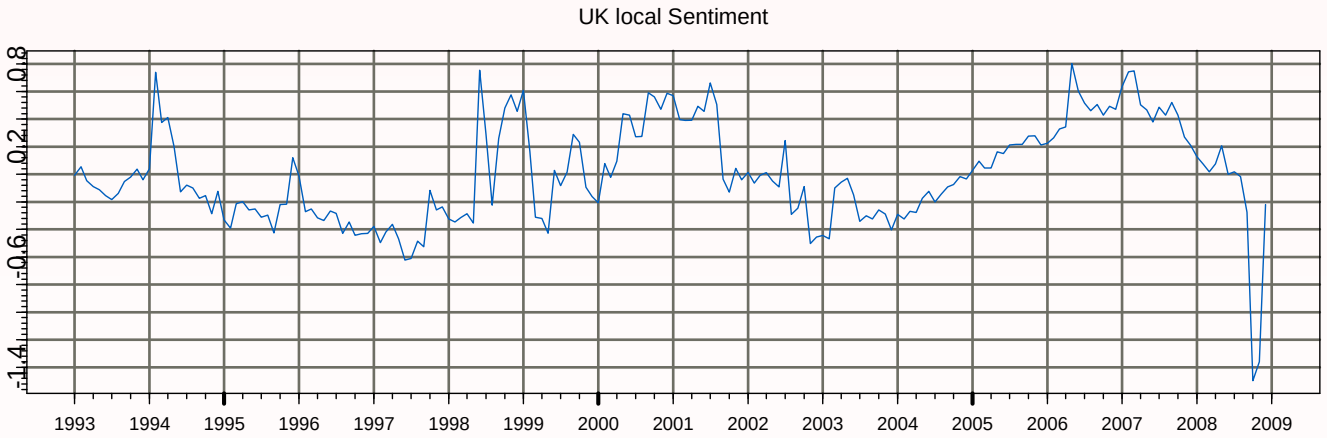
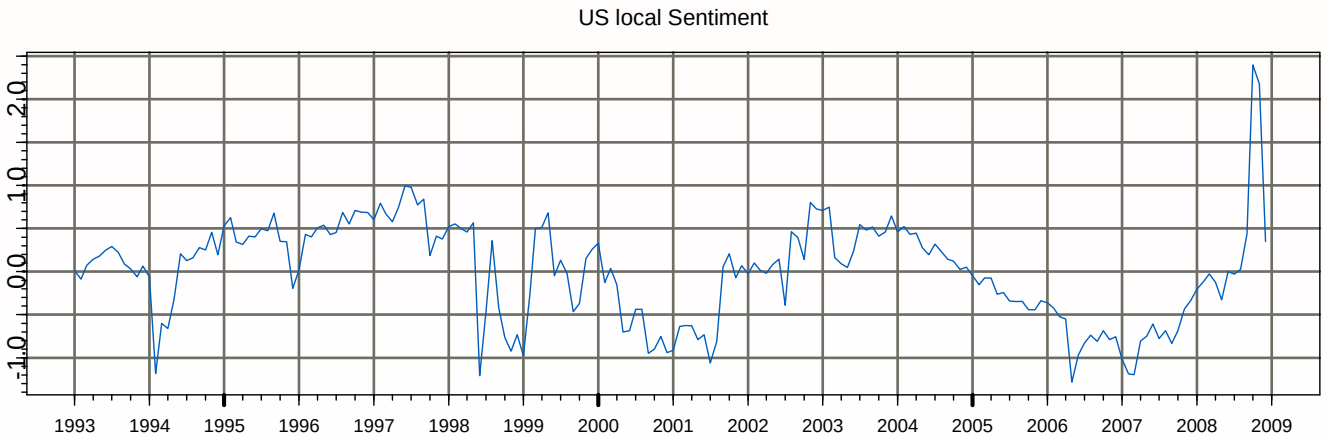
Relative Local Sentiment





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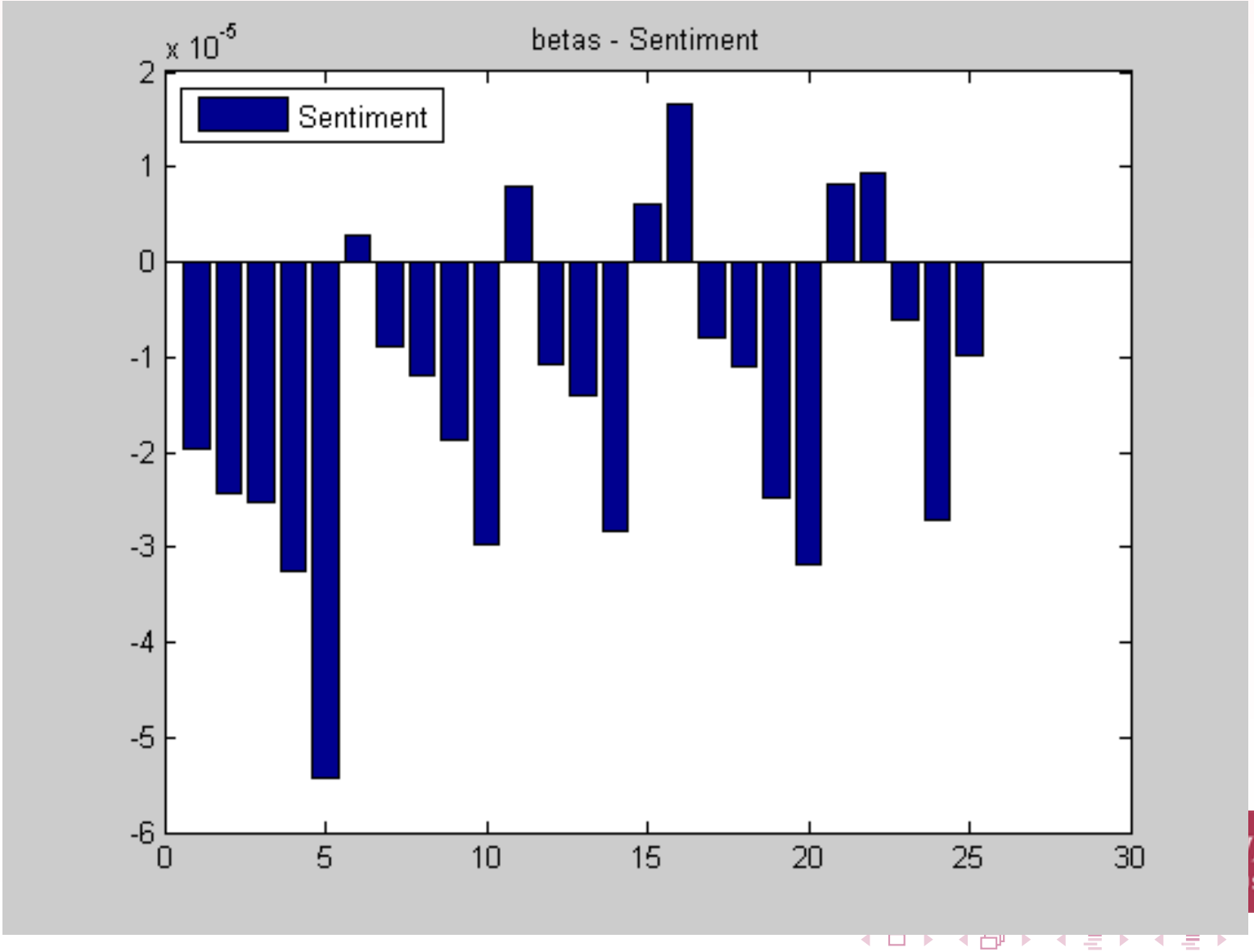
Does Sentiment affect asset allocation?

Analysis of Size and Book to Market Sorted portfolios US

$$r_{it} = \alpha + \beta_1 (r_{Mt} - r_{ft}) + \beta_2 Sent_t + \varepsilon_t$$

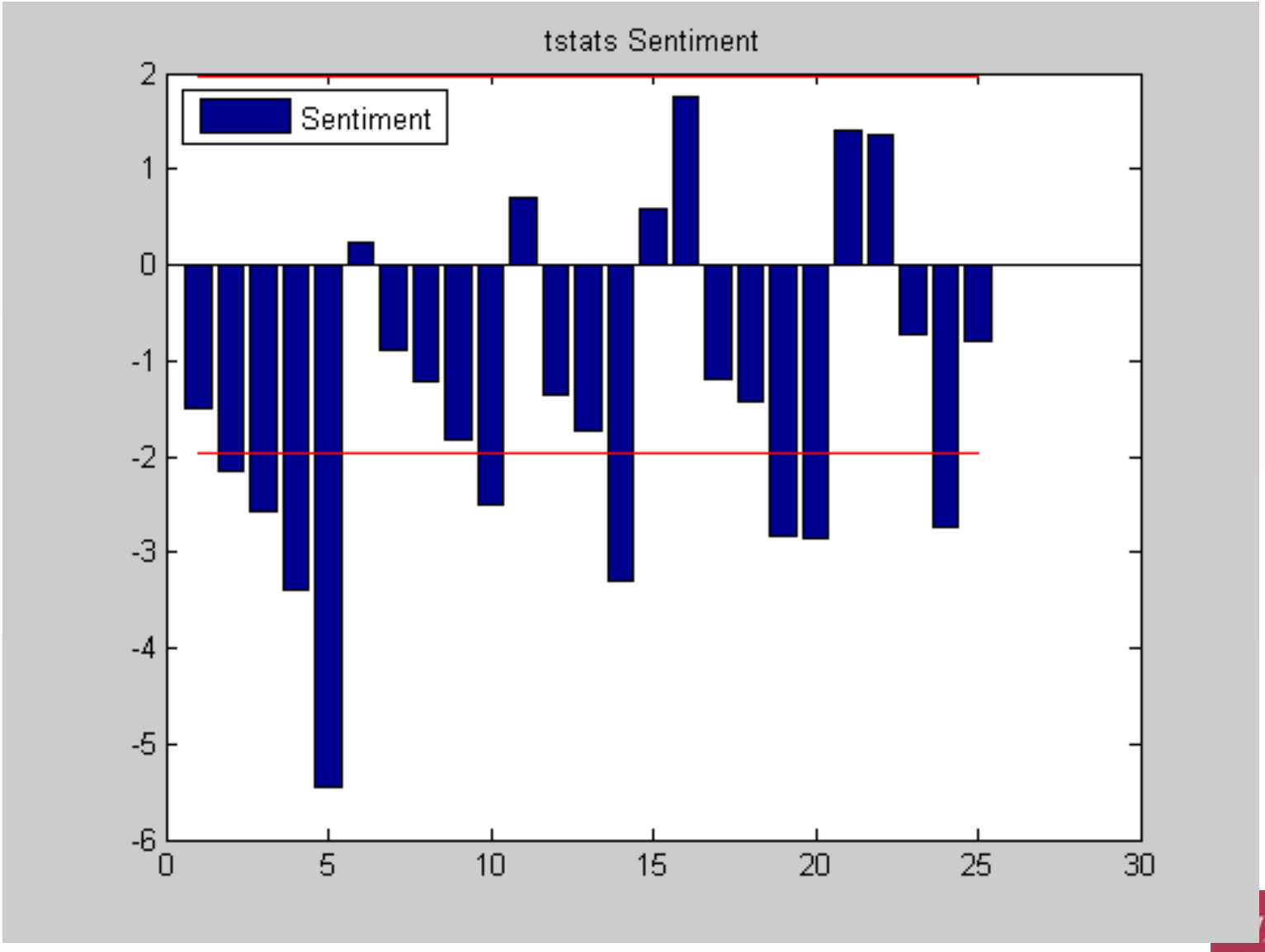
- We first analyse Size and Book-to-Market sorted portfolios for the US market using 25 sorted portfolios from the Fama and French web site.
- The portfolios are sorted as follows, the first 5 columns are for "small caps" and columns 1 to 5 are Low to High Book-to-Market etc. Columns 6 to 10 are for a larger quintile and again double sorted Low to High Book-to-Market.
- The following chart reveals a clear pattern. The sensitivity to sentiment is largest for small stocks and increases from low to high book-to-market portfolios. As Sent is a measure of the price of risk and can be interpreted as 'negative sentiment' we see that small stocks, which are likely to be harder to arbitrage are more prone to sentiment.

Parameter Estimates – US Size and Book-to-Market Sorted Portfolios



- However, with increasing book-to-market value of a portfolio the sensitivity to sentiment increases. This would mean that value stocks are more prone to sentiment than growth stocks.
- From the figure it is also clear that for large caps the relationship with negative sentiment can flip sign and turn positive. This is in line with Baker and Wurgler's argument of large stocks being bond like... but not statistically significant.

t-statistics – US Size and Book-to-Market Sorted Portfolios



- We also examined the impact of sentiment on the spreads individually by estimating the following two regressions

$$SmB_t = \alpha + \beta_1 (r_{Mt} - r_{ft}) + \beta_2 HmL_t + \beta_3 Sent_t + \varepsilon_t$$

Variable	*Coefficient*	*t-statistic*	*t-probability*
α	0.000100	1.275196	0.202298
HmL	-0.124549	-16.296257	0.000000
$(r_{Mt} - r_{ft})$	-0.236970	-16.355068	0.000000
Sent	-0.000018	-1.931861	0.053432

$$HmL_t = \alpha + \beta_1(r_{Mt} - r_{ft}) + \beta_2 SmB_t + \beta_3 Sent_t + \varepsilon_t$$

Variable	*Coefficient*	*t-statistic*	*t-probability*
α	0.000279	3.806600	0.000143
SmB	-0.212013	-31.433407	0.000000
$(r_{Mt} - r_{ft})$	-0.209287	-16.355068	0.000000
Sent	-0.000041	-4.559554	0.000005

Industry Sorted Portfolios

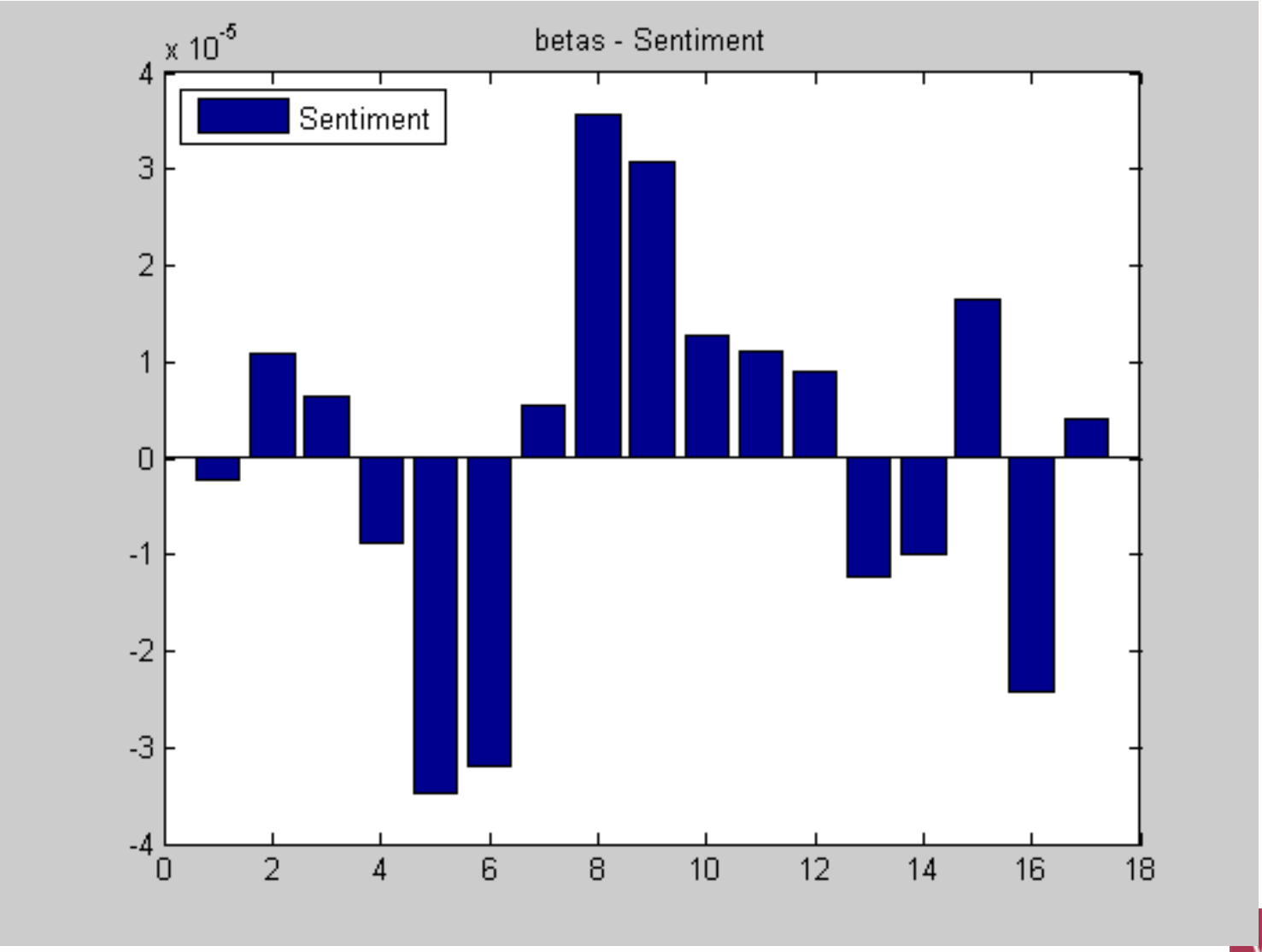
$$r_{it} = \alpha + \beta_1 (r_{Mt} - r_{ft}) + \beta_2 Sent_t + \varepsilon_t$$

- The portfolios appear in the following order: -

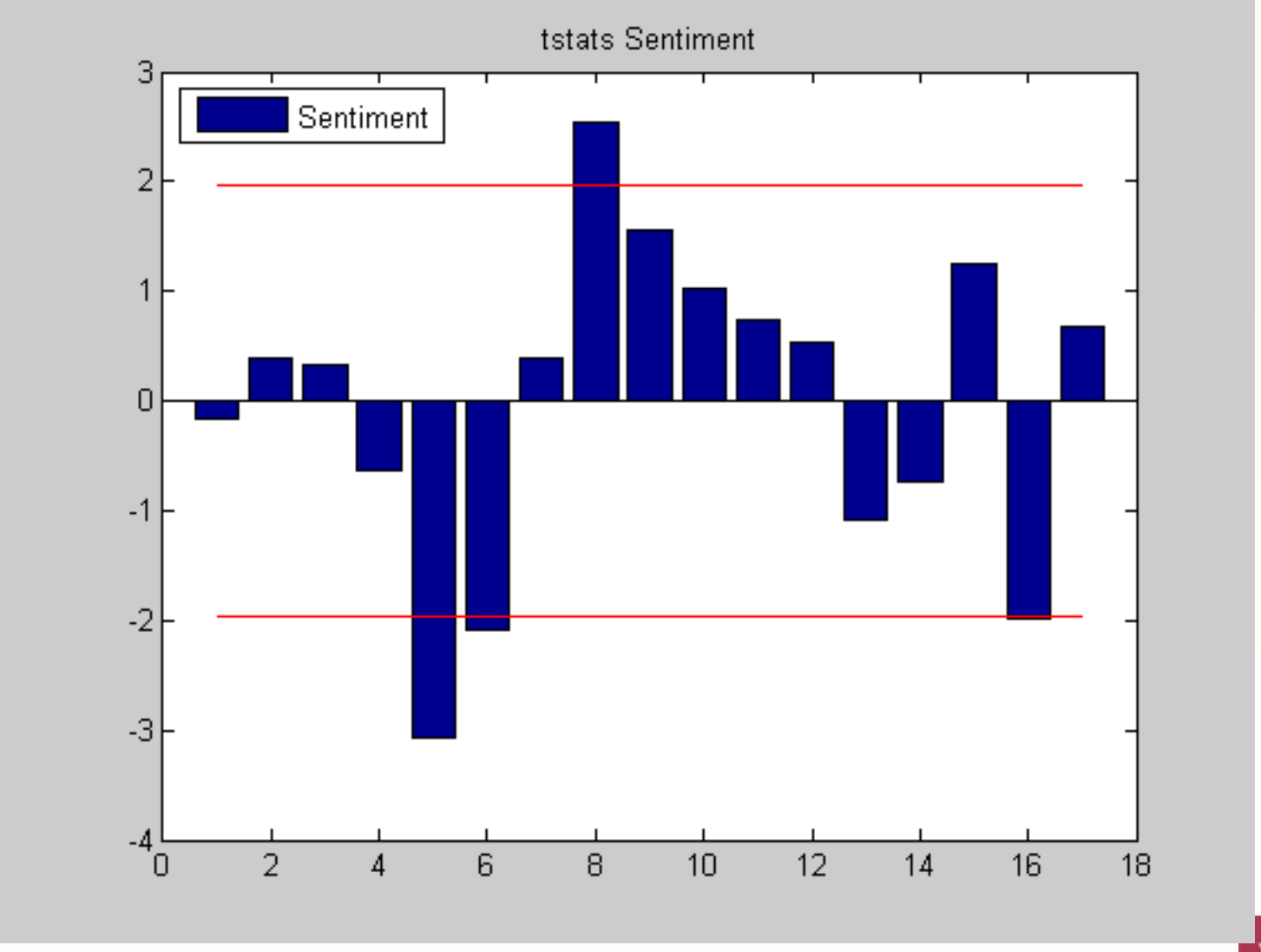
Food, Mining and Minerals, Oil and Petroleum Products, Clothes, Consumer Durables, Chemicals, Consumption, Construction, Steel, Fabricated Products, Machinery, Automobiles, Transportation, Utilities, Retail Stores, Financials, Other

- Sentiment is only statistically significant for Durables , Chemicals, Construction and Financials, with varying signs.
- Durables, Chemicals and Finance indicate that increasing price of risk has negative effect on their returns
- On the other hand, the Construction industry portfolio appears to be positively related and significant, which is somewhat surprising.
- This could either indicate a lagged effect within the construction industry to decreases in investor sentiment or possibly a flight to safety when investors try to diversify their portfolios with alternative assets when the market price of risk increases.

Sentiment and Industry sorted Portfolios



t stats on Industry sorted Portfolios



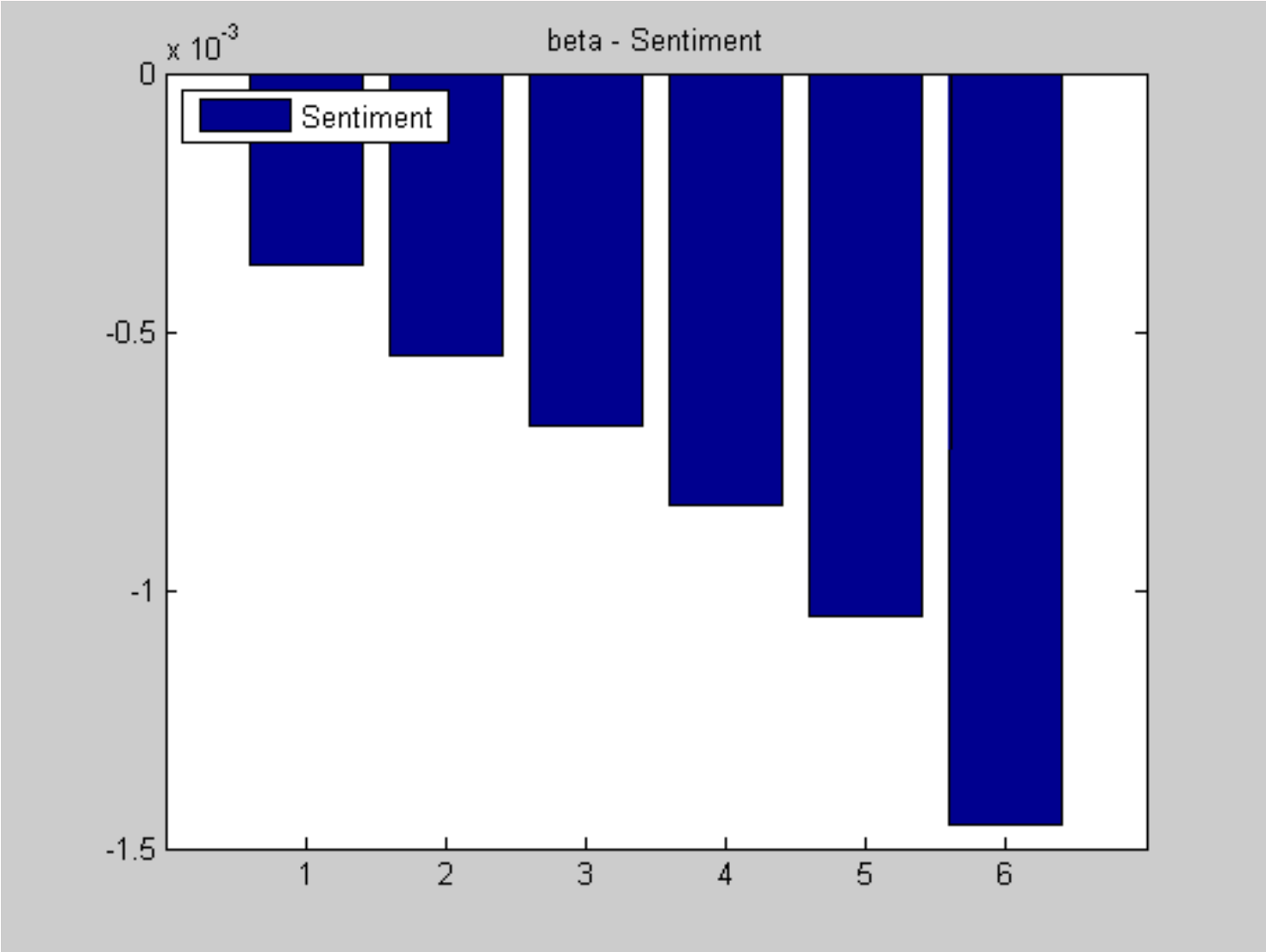
Volatility Sorted Portfolios

$$r_{it} = \alpha + \beta_1 (r_{Mt} - r_{ft}) + \beta_2 Sent_t + \varepsilon_t$$

- Following Baker and Wurgler we next examine the effect of Sentiment on six portfolios sorted by volatility with the underlying hypothesis that high volatility stocks are harder to arbitrage and are thus more prone to investor sentiment.
- The stocks in the US universe and the UK universe drawn from MSCI.
- In order to sort the portfolios, we compute the volatility of each stock over the past year and sort the stocks into 6 groups, repeated period by period until the end of the sample.

- The following figures reveal a clear monotonic pattern, especially for the US, and all parameters are significant.
- The higher the volatility of the portfolio the more prone it is to investor sentiment.
- The monotonicity in the UK volatility sorted portfolios is not as clear for the UK. The fifth highest volatility portfolio parameter is slightly smaller than the fourth .
- Nonetheless, the pattern seems to be clear for both UK and the US. We thus confirm Baker and Wurgler's hypothesis with our sentiment index.

Parameter Estimates – US Volatility Sorted Portfolios



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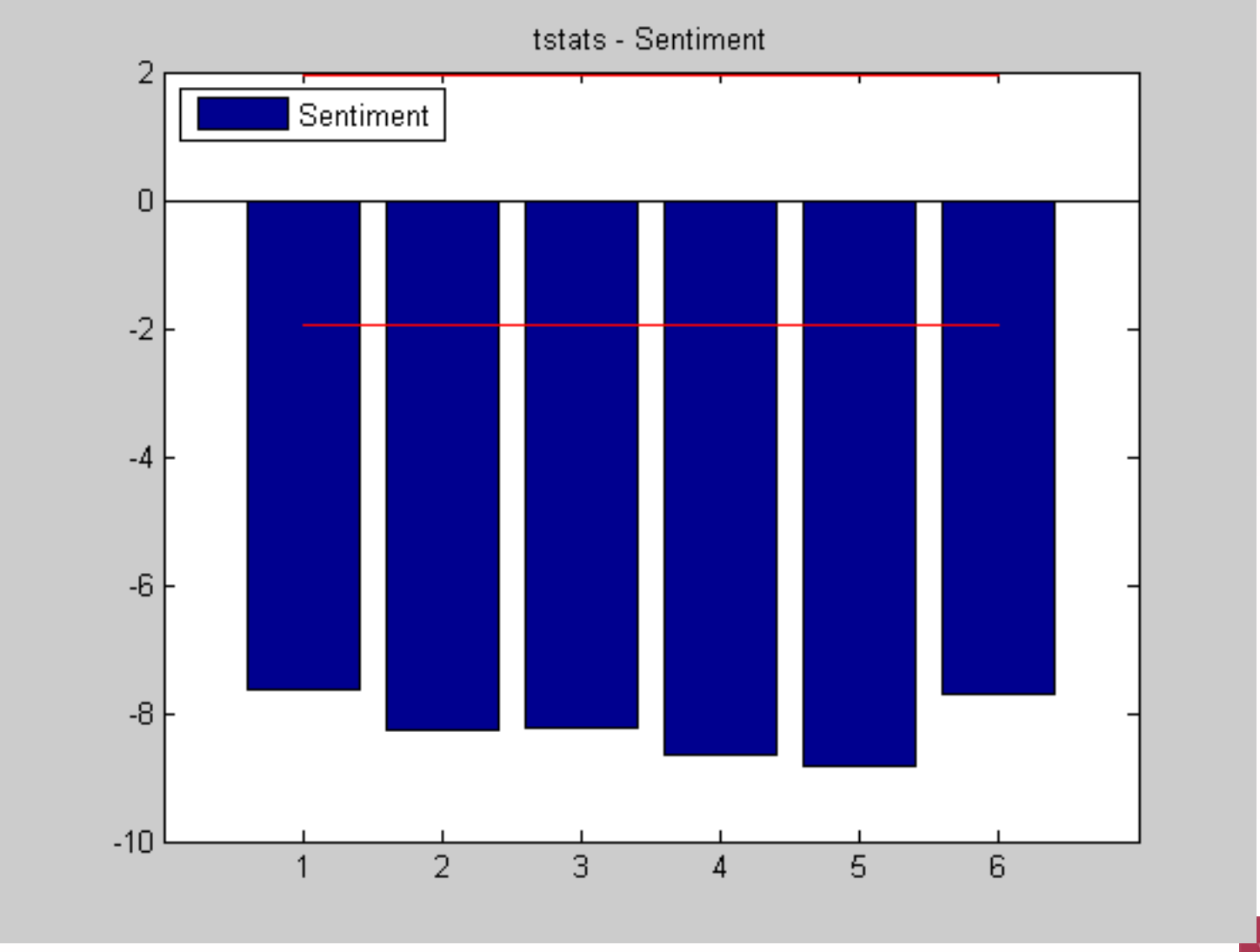
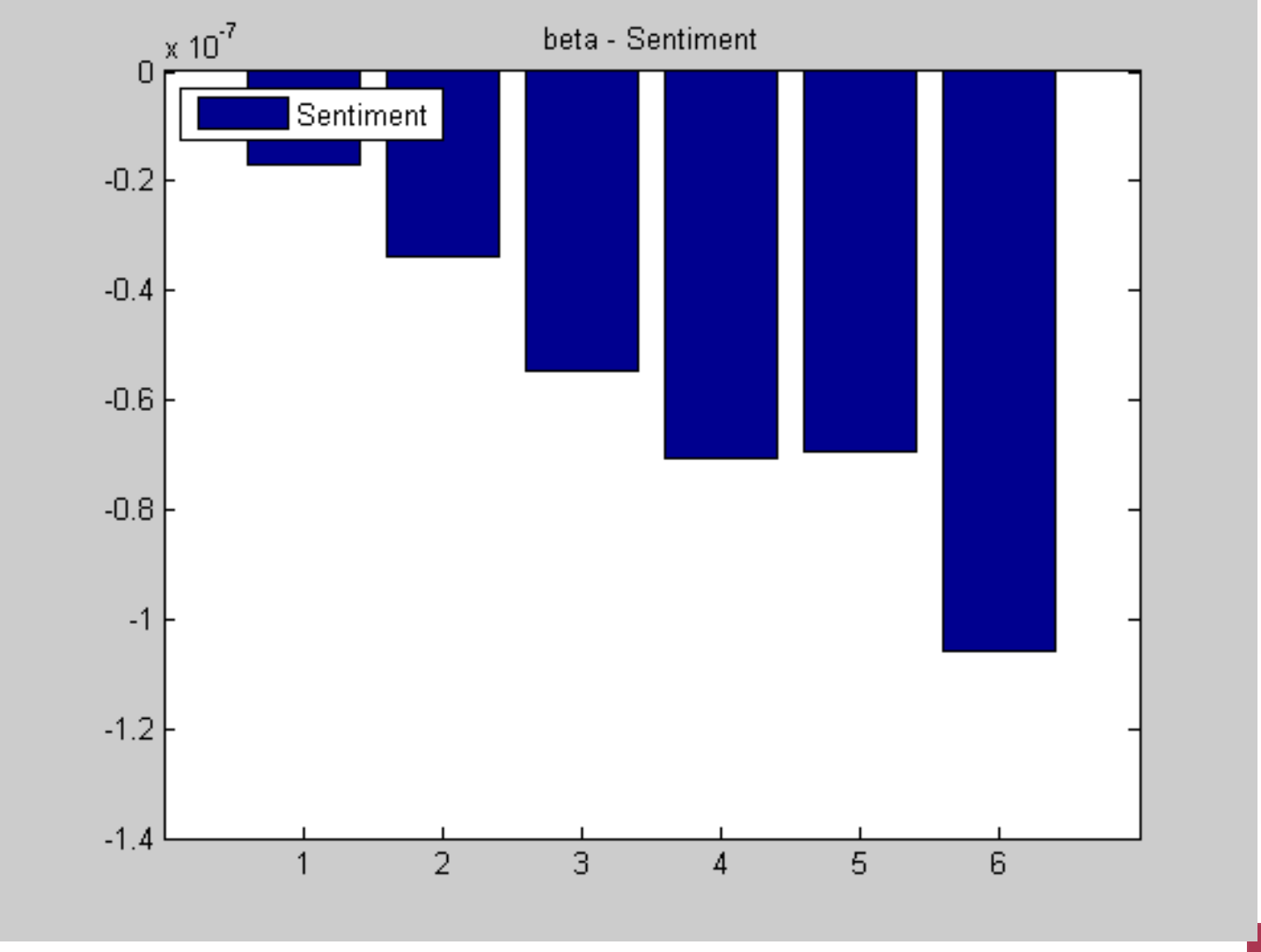
t-statistics – US Volatility Sorted Portfolios



Parameter Estimates – UK Volatility Sorted Portfolios



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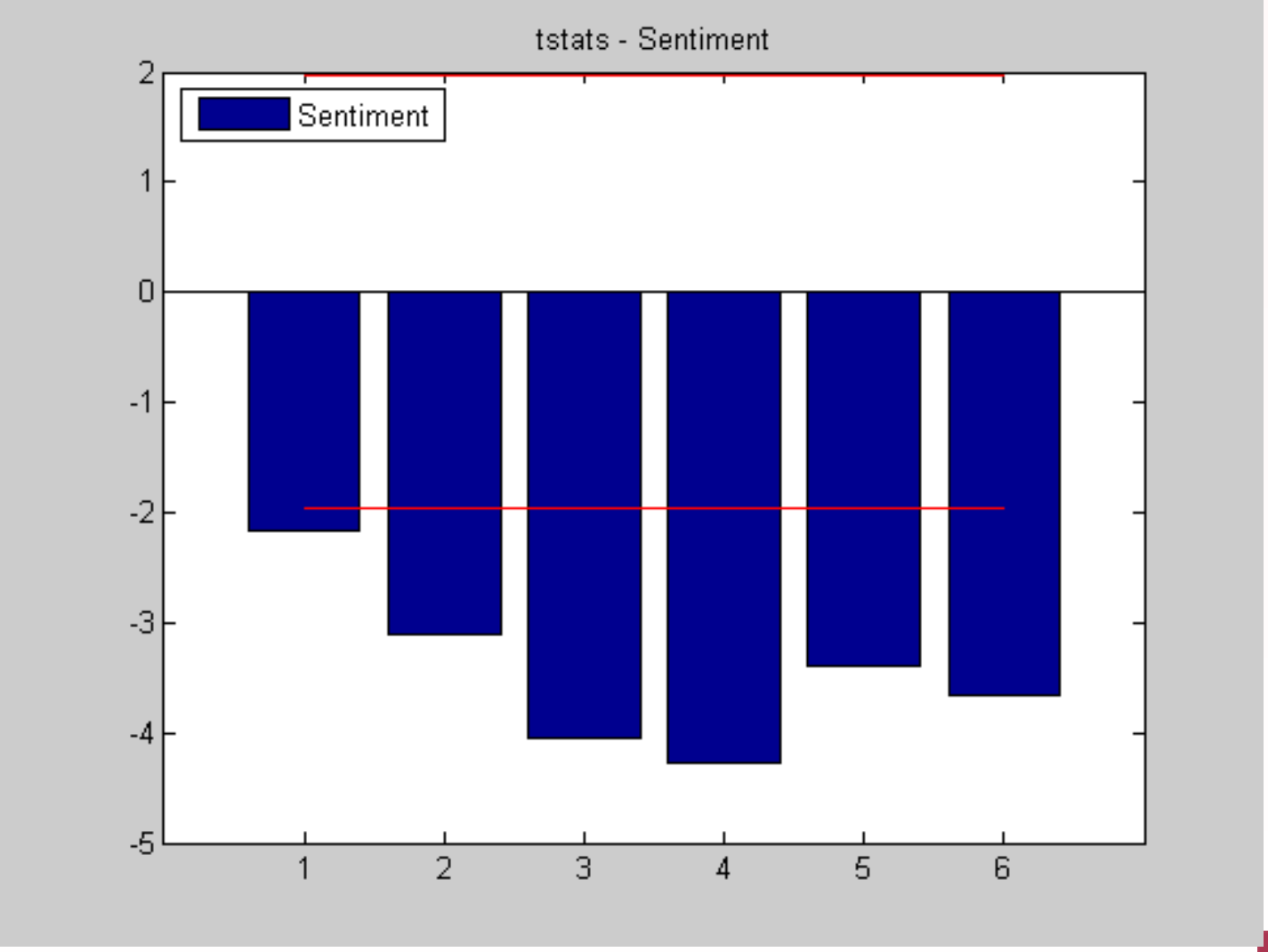
t-statistics – UK Volatility Sorted Portfolios



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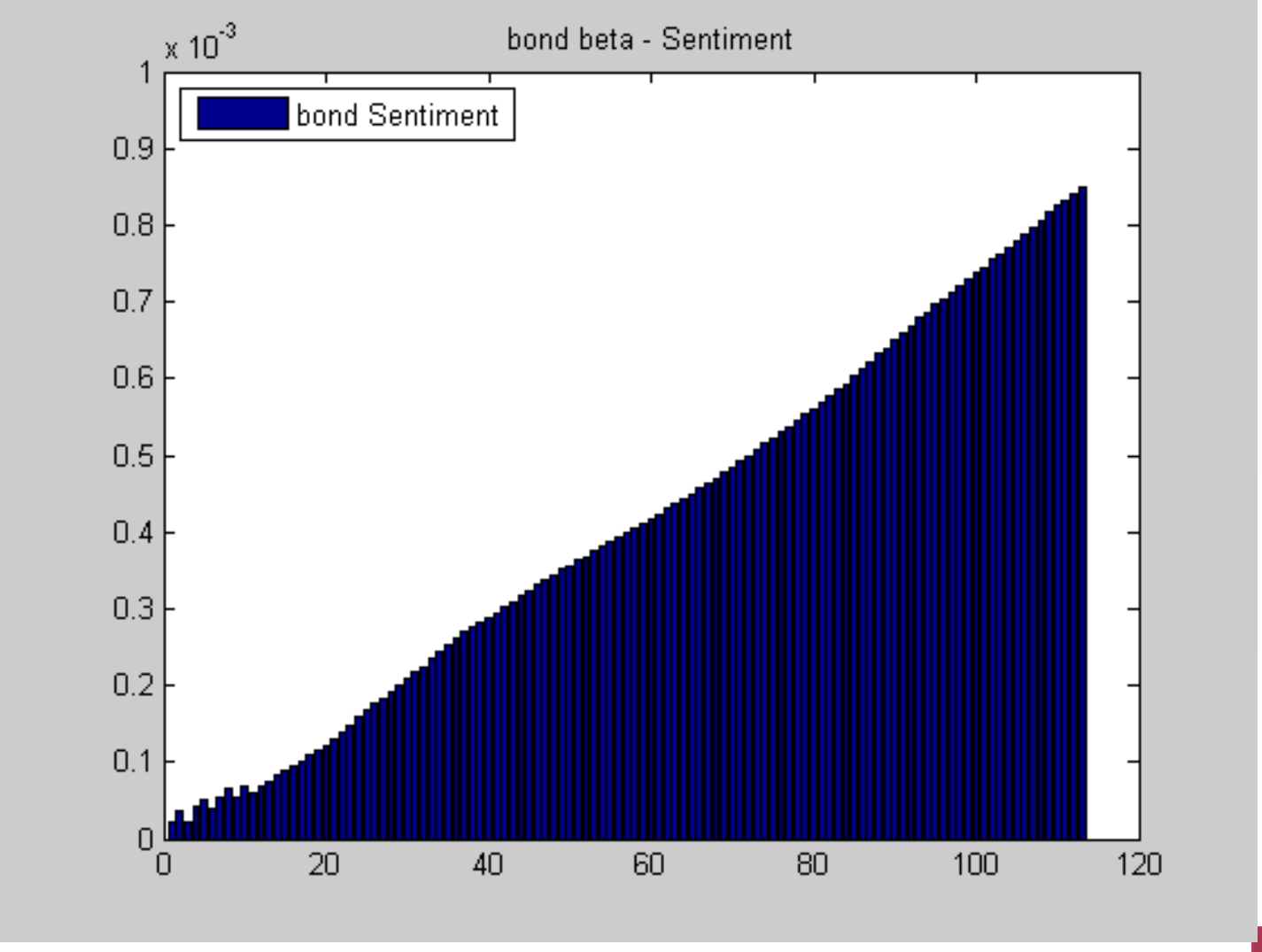
Impact of Investor Sentiment on Bond Markets

- Baker and Wurgler (2008) find that investor sentiment is most significant in explaining government bond returns and corporate bond returns with high credit rating.
- They attribute this to the flights to quality argument. When investor sentiment becomes bearish investors try to close their risky positions and fly to safe heaven - government bonds.
- We compute log holding period US government bond returns in excess of one month LIBOR rate for maturities from 1 month to 120 months using a sample from January 1999 to December 2008.
- We regress each of these excess holding period returns on our sentiment indicator and plot the estimated parameters.

- A clear pattern emerges. As the duration of the bond portfolio (of one single bond) increases it become more risky and thus more prone to sentiment.
- The increasing sensitivity of government bonds as the maturity increases *also* reveals that with rising duration the bond is harder to arbitrage.
- In particular after a government bond is issued it is actively traded for a few weeks and then trading activity and liquidity decreases substantially.
- It is thus harder to arbitrage a long term bond after the price of risk has increased.
- We see for all maturities that an increase in the price of risk –a decrease in investor sentiment- has a positive effect on government bond returns. This is in line with the flight to quality argument. Moreover, all parameters are statistically significant.

Impact of Investor Sentiment on US Government Bonds



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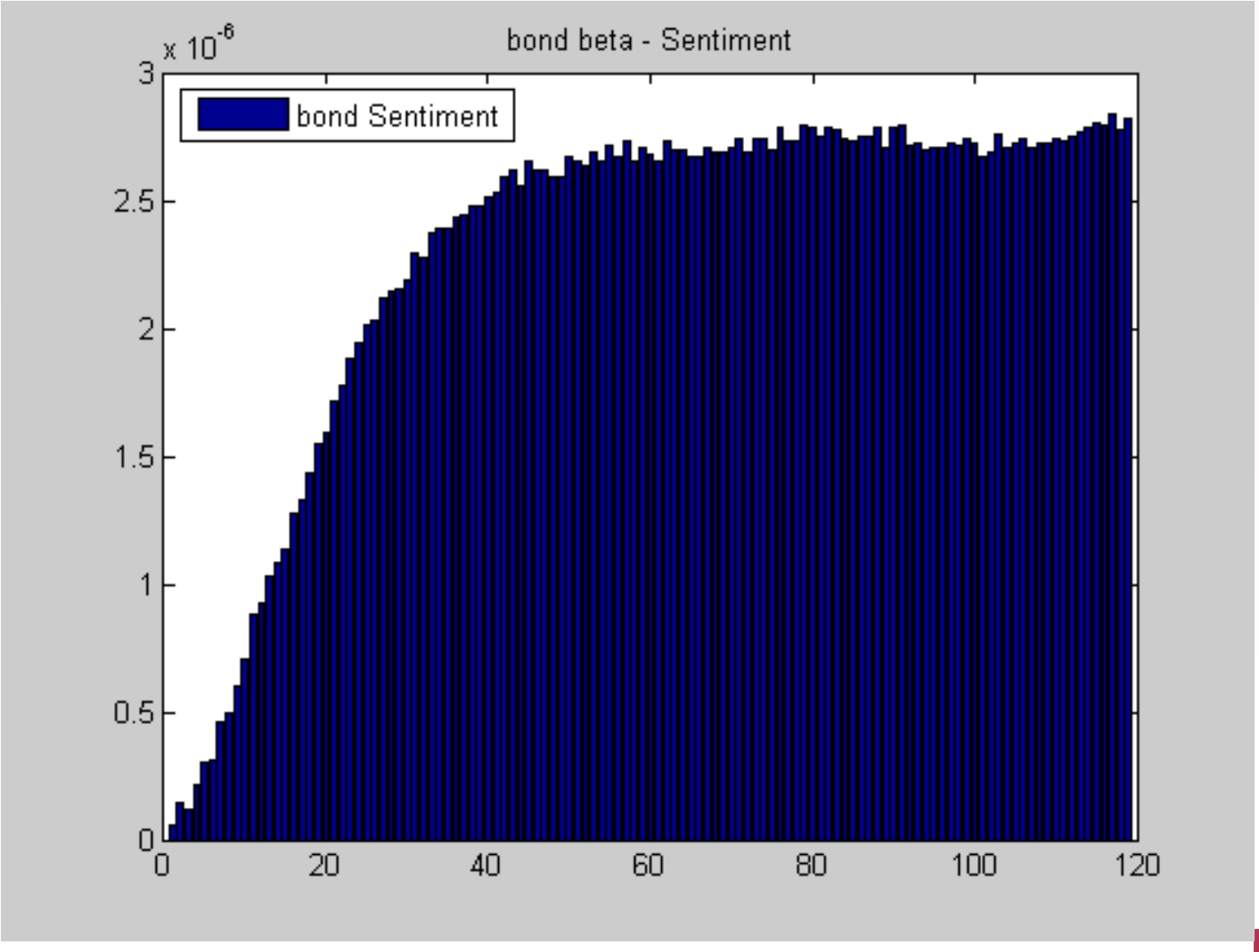
Impact of Investor Sentiment on UK Government Bonds



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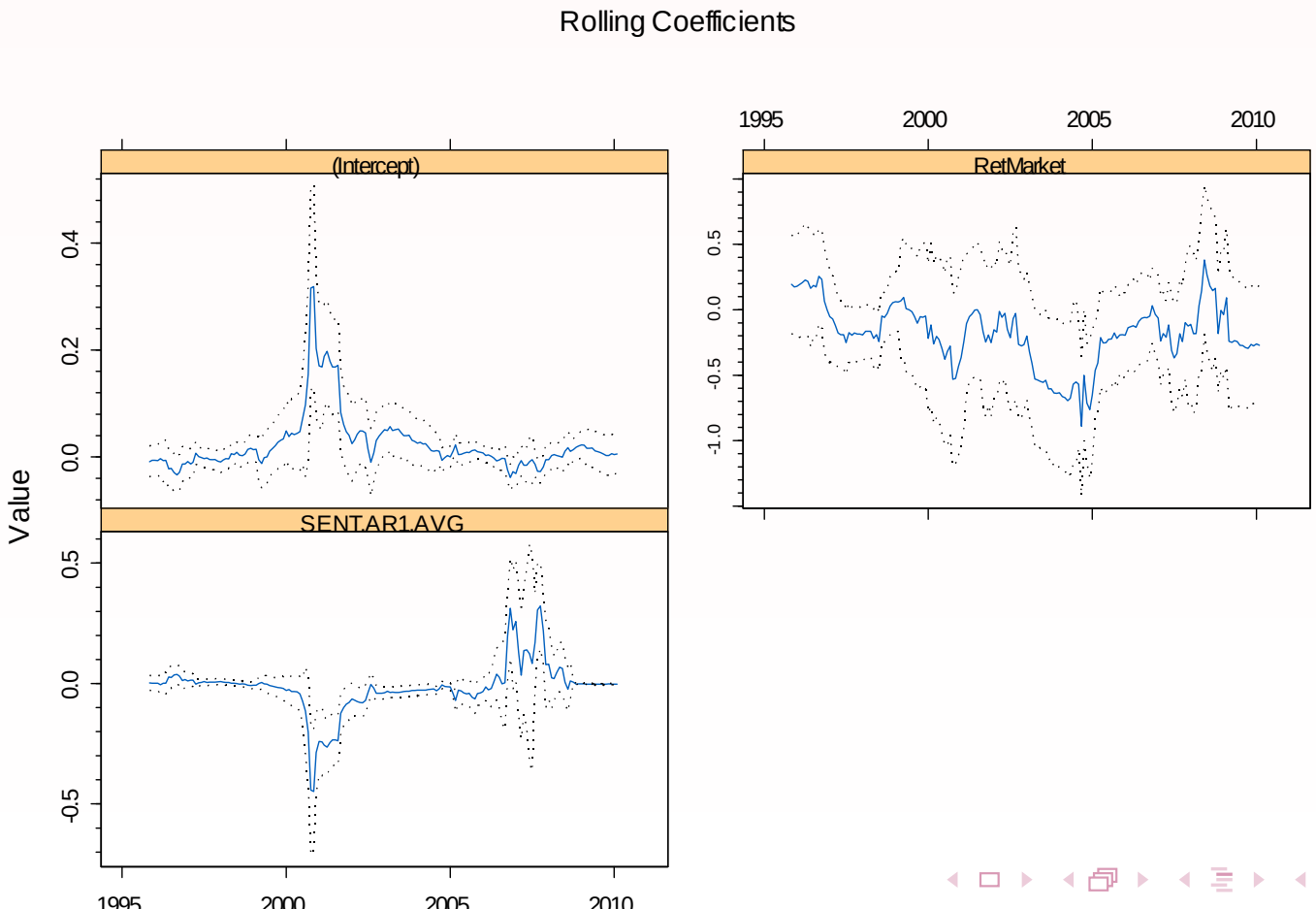
Is the market fairly valued?

- We have seen how Sentiment can vary over market states and can affect asset allocation- over the whole sample but is it significant always– when it is not significant then we can say the market is fairly valued- recursive estimation shows us the following:-



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Conclusions

- This research is still work in progress so any conclusions are preliminary but...
- We have developed a new, theoretically based, measure of Sentiment based on estimating the price of risk in financial markets
- It appears to move in an intuitive and sensible way with the markets.In addition we find clear differences between the US and UK markets.
- Although its correlation with the Baker Wurgler proxy for the US is low we somewhat surprisingly find very similar conclusions.
- There appears to be a clear impact of Sentiment on both equity and bond markets - patterns of dependency that could be exploited in cross-sectional asset allocation but not always-
- As it seems that for large parts of the sample period the Sentiment effect was close to zero indicating the market was approximately fairly priced.