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Is investor sentiment contagious? International sentiment and UK equity returns

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Abstract

This paper contributes to a growing body of literature studying investor sentiment. Separate sentiment measures for UK investors and UK institutional investors are constructed from commonly cited sentiment indicators using the first principle component method. We then examine if the sentiment measures can help predict UK equity returns, distinguishing between "turbulent" and "tranquil" periods in the financial markets. We find that sentiment tends to be a more important determinant of returns in the run-up to a crisis than at other times. We also examine if US investor sentiment can help predict UK equity returns, and find that US investor sentiment is highly significant in explaining the UK equity returns.

Keywords: Investor sentiment; contagion; institutional investors; equity returns

JEL Classification: G02, G12, G14

1. Introduction

We investigate the influence on UK equity returns of foreign and local components of investor sentiment, using measures of sentiment for the UK and US. The objectives of the paper are two. First we construct two new measures of investor sentiment for the UK at a weekly frequency, distinguishing between "market" and "institutional" sentiment, on the grounds that financial institutions may be expected to be better-informed about the stock market than other investors. Institutions may therefore develop sentiment about stocks in different ways from the market in general, for example: perhaps more rapidly or simply using different information sets. Second, we study the impact of investor sentiment in the US and the UK on UK equity returns, both in general, and more specifically distinguishing between "tranquil" market periods and periods of "financial crisis", when there were sharp falls in the market.

Empirical studies of financial markets have uncovered numerous anomalies and puzzles, where asset returns behave in ways that traditional finance theories struggle to explain. Examples include: short horizon stock price momentum (Jegadeesh and Titman, 1993), long-run mean reversion (Debondt and Thaler, 1985) and excess volatility (Shiller, 1981). To explain these and other anomalies, finance research has been extended to include the direct study of market participants, integrating psychological insights with neo-classical economic theories. Much of this literature is concerned with investor sentiment: its formation, development and possible impact on share returns. Seminal examples include Kahneman and Tversky (1973, 1974), De Long, Shleifer, Summers, and Waldmann, (1990), Daniel, Hirshleifer and Subrahmanyan (1998), Odean (1998), and Barberis, Shleifer and Vishny (1998). These studies demonstrate that investor sentiment may divert asset prices from their "rational, fundamental" values.

Baker and Wurgler (2007) define investor sentiment as "…a belief about future cash flows or investment risks that is not justified by the facts at hand." Not surprisingly therefore, one of the most difficult empirical questions concerning investor sentiment is that of how it should be measured. Three methods are common. The first uses survey-based techniques that involve asking people about their thoughts and expectations about the stock market. These aim to produce a measure of sentiment that captures the mood of investors. Examples include the American Association of Individual Investors (AAII) and Investors Intelligence (II) surveys (Brown, 1999; Verma & Soydemir, 2006; Fong 20013). More general indices such as the Consumer Confidence Index have also been studied (Schmeling, 2009). The second method is to employ more "objective"

financial market indicators, such as the put-call trading ratio and indices of volatility (Wang, Keswani & Taylor, 2006). Third are composed indices typically using principal components to extract a single sentiment measure from a variety of relevant economic and financial data (Brown and Cliff, 2004; and Baker and Wurgler, 2006).

All three methods have their drawbacks. Surveys are expensive to conduct reliably at high frequency and "quick" questionnaires may produce answers which are less reliable. Financial market data are in theory more accurate but they involve a risk of circularity as they may simply reflect the outcome of share price movements rather than be an independent measure of sentiment. Wang, Keswani and Taylor (2006) study the ratios of Put-call trading, Put-call open interest and Advances-to-declines; and find that these sentiment indices are Granger-caused by stock returns but do not themselves cause returns. Finally, the use of principal components to create a composed index produces a variable which may not be very robust. The composition of the principal components may change as new data become available, implying that the entire time series of sentiment may change over time. However, composed indices are probably the most popular of the three sentiment measures, particularly in studies of US data, arguably because they do largely overcome the reliability issues of surveys and the independence issues of pure financial market data.

In this paper we use principal components to construct indices of investor sentiment for UK market-wide sentiment and UK institutional investor sentiment. Principal components analysis extracts orthogonal time series from a dataset in such a way that each successive principal component accounts for as much as possible of the (residual) variation in the dataset. Brown and Cliff (2004) argue that the first principal component of various financial market indicators is sufficient to provide a reliable measure of unobserved sentiment. This procedure is now a generally accepted method of measuring investor sentiment, and has been used *inter alia* by Baker and Wurgler (2006, 2007), Chen, Chong and Duan (2010), Baker, Wurgler, and Yuan (2012), Chen, Chong and She (2014) and Bai (2014) to construct sentiment indices for various countries so as to examine the effect of sentiment on stock returns. Notwithstanding the popularity of this method, few composed sentiment indices have been constructed for the UK. In fact, the only two as far as we are aware is an annual market-wide index by Baker, Wurgler, and Yuan (2012), and a weekly market-wide index by Bai (2014) based on the Baker and Wurgler (2006) approach.

Furthermore, there are no survey-based investor sentiment indices available for the UK[1].

In contrast, the UK market-wide investor sentiment index composed in our paper includes a more comprehensive range of investor sentiment proxies, based as it is on combining the approaches of Brown and Cliff (2004) and Baker and Wurgler (2006). We also construct an index of institutional investor sentiment, the first such that has been constructed for the UK. Institutional investors increasingly dominate world-wide equity-holdings, particularly in the UK and the US (Davis, 2002). According to Ownership of UK Quoted Shares, released by Office for National Statistics[2], the percentage of total market value of UK quoted shares owned by Unit trusts and investment trusts increased from 10.1% in 1994 to 18% in 2012, and foreign share ownership increased from 16.3% to 53.2% in the same period. 83.4% of the foreign owners in 2012 are financial institutions. It is therefore important to understand whether institutional sentiment differs markedly from general market sentiment and how any differences affect stock price movements.

The second objective of the paper is to study the impact of sentiment on stock returns in the UK. There is broad agreement that, even after controlling for "rational" influences such as mean-variance (Yu and Yuan, 2011) and Fama-French factors[3] (Xu and Green, 2013), indicators of sentiment do contribute significantly to explaining the time series and cross-sectional behaviour of stock returns in a variety of settings. The preponderance of the evidence from a variety of datasets and measures of sentiment is that unusually high levels of sentiment tend to be associated with increased trading (Brown, 1999), greater volatility (Lee, Jiang and Indro, 2002), and lower returns (Brown and Cliff, 2004; Schmeling, 2009).

Furthermore, evidence for the US suggests that there are differences between the effects of market and institutional sentiment and as among different types of firm and market environment. Brown and Cliff (2004) find that the negative relationship between sentiment and stock returns differs in strength between the AAII and II surveys; and is stronger for large or growth firms than for small or mature firms. However, virtually all this evidence concerns US sentiment and US stock returns, with only limited extant research on other countries. In addition, the outcomes of possibly sentiment-driven behaviour such as momentum and reversal have been shown to vary systematically as between up-markets and down-markets (Cooper, Gutierrez and Hameed, 2004);

1 The European Commission *Business and Consumer Surveys* for EU members is only available monthly and is concerned with general business and consumer confidence rather than investor or financial market sentiment.

2 Data source: www.ons.gov.uk/ons/datasets-and-tables/index.html?content-type=Dataset&edition=tcm%3A77-308158

3 Fama and French (1996).

but to our knowledge the direct impact of sentiment on returns in different market states has not been investigated. We study the relation between sentiment and UK stock returns, distinguishing on the one hand between general market and institutional sentiment, and on the other between large, mid-size and small stock portfolios. We also distinguish between "tranquil" and "crisis" periods in the stock market and between "high" and "low" sentiment periods.

Finally, we examine the relative strength of UK and foreign sentiment (represented by US sentiment) in the determination of UK stock returns. Becjann et al. (2011), Baker, Wurgler and Yuan (2012) and Bai (2014) discuss three channels through which investor sentiment contagion may occur. First, if investors in one country are optimistic (say) about investment prospects in another country, they may bid up the shares of that particular country. Second, if investors in one country are optimistic, this may cause a general shift into risky assets, including international equities. Both these channels postulate that the effect of foreign sentiment on home country share prices occurs through market purchases by foreign residents. Third, when foreign investors are optimistic about their own economy this leads to domestic investors being optimistic about the local economy due to the linkage between the two economies, the foreign sentiment affecting domestic share prices indirectly via domestic sentiment.

We argue that there is a fourth possible mechanism: sentiment in a foreign country may affect sentiment in the home country directly because of the herding instinct of noise traders, and through this channel affect share prices, as home country residents become more or less optimistic and trade accordingly. It is well-established that "word-of-mouth" social interactions can affect sentiment and investment decisions (Shiller, 1984; Brown, Ivković, Smith and Weisbenner, 2008). Investors in different countries are not usually as geographically close to one another as the investors that Shiller and Brown *et al* investigated. However, internet message boards have a global reach and there is evidence that they influence sentiment and trading (Sabherwal, Sarkar and Zhang, 2011). Furthermore, foreign sentiment can become local where there is a relatively high proportion of foreign ownership of locally-listed stocks, as is the case in the UK. At end-2012, foreign investors owned 53.2% of the value of the UK stock market; of this, 48.3% was held by investors in North America[4]. Investing is a global business, and it seems plausible that (for example) US fund managers based in the UK might be as ready to listen to their US counterparts as well as to their British colleagues in London. Therefore, the hypothesis is that there may be direct contagion from sentiment in one country to sentiment in another, associated with an impact

[4] Office of National Statistics, Ownership of UK quoted shares 2012. www.statistics.gov.uk.

on share prices.

In summary we make two contributions to the growing body of literature on investor sentiment by providing an empirical examination of sentiment in the UK. One is that we construct new measures of UK investor sentiment using the first principle component method. We build one index for overall market sentiment and a second for UK institutional investor sentiment. The other is that we study the impact of investor sentiment on UK asset returns differentiating the analysis by company size, market states, and country in which sentiment originates (UK or US).

Four key results of the paper are worth stating at the outset. First, we find that UK sentiment is Granger-caused by US individual and institutional sentiment, but not the reverse. Second, we find that when US and UK sentiment are included in the same regression, UK equity returns are significantly influenced by US individual and institutional sentiment and not at all by UK investor sentiment: suggesting that UK stock returns are affected by investor sentiment that is "born in the USA". This could be due to the high proportion of foreign investors holding UK shares as noted above, or to other factors, but it would certainly appear to warrant further investigation. Third, sentiment tends to be a more important determinant of stock returns outside crisis periods than in a crisis. This is consistent with previous evidence that, in a financial crisis, prices revert back to fundamentals, as they are no longer driven by sentiment. Fourth, we find pervasive evidence that changes in sentiment contribute to market volatility, *ceteris paribus*. The signs of lagged sentiment coefficients in stock return regressions suggest that investors invariably have "second thoughts": if sentiment has a significant positive coefficient in the returns regression, lagged sentiment invariably has a significant negative and substantially offsetting coefficient, and *vice-versa*.

The rest of the paper is organised as follows: section 2 describes the data used in the study including the new UK sentiment indices that we construct; in section 3 we examine the relationships, particularly the causal orderings, between UK investor sentiment on the one hand and US investor sentiment on the other; section 4 investigates how UK and US investor sentiment affect UK equity returns; section 5 contains some concluding remarks.

2. Construction of the UK Sentiment Indices and Other Data

The data making up the UK sentiment indices are weekly and cover the period 1st January 1996 to

30th June 2011. Previous work suggests several variables that can be used as proxies for sentiment and we use eight underlying variables to construct the UK sentiment measures. These are: the Advances to Declines ratio (AVDC), that is usually interpreted as a measure of market strength; the Closed-end Fund Discount (CFED), one of the earliest indicators of sentiment; the Money Flow Index (MFI), a momentum indicator; the Put-call Trading Volume ratio (PCV), a standard measure of bear-bull sentiment; the Put-call Open Interest ratio (PCO), which has been argued to be superior to PCV; the Relative Strength Index (RSI); Realized Volatility (VOLA); and Trading Volume (VRA). Augmented Dickey-Fuller (ADF) tests show that these variables are all covariance-stationary apart from VRA (Table 1). A further ADF test of the first difference of VRA (DVRA) shows that it is stationary. Therefore, we construct the sentiment indices using DVRA and the levels of the remaining indicators.[5]

[5] Detailed definitions of these indicators are set out in Appendix 1.

Table 1: Statistics of Basic Data

Table 1 provides summary statistics of the basic data series. The data are weekly and cover the period 1st January 1996 to 30th June 2011 (809 observations). Exceptionally the *SENTIX* index is available only from 28th February 2001 (532 observations).

Variable definitions:
AVDC: Advances to declines ratio; **CEFD**: Closed-end Fund Discount; **MFI**: Money Flow Index; **PCV**: Put-call volume ratio; **PCO**: Put-call open interest ratio; **RSI**: Relative Strength Index; **VOLA**: Realized volatility; **VRA**: Trading volume; **DVRA**: first difference of Trading volume; **AAII**: American Association of Individual Investors index; **II**: American Investors Intelligence index; **SENTIX**: German equity sentiment index; R_{big}: return on the large-size stock portfolio; R_{mid}: return on mid-size stock portfolio; R_{small}: return on small-size stock portfolio.
AC (1) is the autocorrelation coefficient at one lag. **ADF** is Augmented Dickey-Fuller test statistic with maximum 52 lags.

Variable	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Sum Sq. Dev.	AC (1)	ADF
AVDC	1.0876	0.4549	1.2329	6.0842	525.589***	167.2282	0.005	-28.3206***
CEFD	6.1710	1.9384	0.5394	4.4652	111.5912***	3035.919	0.946***	-4.1802***
MFI	55.0233	23.520	-0.0673	2.3014	17.06343***	446983.2	0.799***	-6.0015***
PCV	1.3526	0.4580	1.1055	6.3486	542.7550***	169.5227	0.169***	-9.8230***
PCO	1.1830	0.1956	0.2522	2.1609	32.30725***	30.90311	0.962***	-3.9491***
RSI	49.2066	25.7137	-0.4768	1.8330	76.4642***	533584.7	0.872***	-7.9520***
VOLA	1.0117	0.6030	2.6823	14.4282	5372.483***	293.8059	0.820***	-6.4611***
VRA	1.0261	0.1729	0.9335	7.7472	877.1272***	24.1509	0.926***	-1.2628
DVAR	0.000003	0.0663	0.4674	6.5852	462.1597***	3.5507	0.512***	-10.2222***
AAII	0.1092	0.1933	-0.0893	2.7079	3.942019	30.1047	0.672***	-9.2572***
II	0.1863	0.1353	-0.7417	3.5538	84.51907***	14.7866	0.939***	-5.9866***
R_{big}	0.0575	2.4710	-0.3221	6.2673	373.8274***	4933.496	-0.091***	-31.1141***
R_{mid}	0.1399	2.4603	-0.4941	5.6379	267.4875***	4890.773	0.041	-27.2452***
R_{small}	0.0393	2.1286	-0.5987	6.9675	578.9446***	3660.873	0.320***	-11.8891***

Table 2 Pairwise correlations for variables used in the analysis

Correlations use 806 observations from 17th January 1996 to 29th June 2011

Variable definitions:
AVDC: Advances to declines ratio; **CEFD**: Closed-end Fund Discount; **MFI**: Money Flow Index; **PCV**: Put-call volume ratio; **PCO**: Put-call open interest ratio; **RSI**: Relative Strength Index; **VOLA**: Realized volatility; **VRA**: Trading volume; **DVRA**: first difference of Trading volume; **AAII**: American Association of Individual Investors index; **II**: American Investors Intelligence index

***Statistical significance at 1% level; **Statistical significance at 5% level; *Statistical significance at 10% level

Correlation	AAII	II	AVDC	CEFD	DVRA	MFI	PCO	PCV	RSI	VOLA
AAII	1.000									
II	0.507***	1.000								
AVDC	0.169***	0.129***	1.000							
CEFD	-0.141***	-0.255***	0.068*	1.000						
DVRA	-0.019	-0.054	-0.094***	-0.034	1.000					
MFI	0.335***	0.404***	0.118***	-0.105***	-0.148***	1.000				
PCO	-0.136***	0.167***	-0.001	-0.260***	0.027	0.117***	1.000			
PCV	-0.129***	0.092***	-0.085**	-0.179***	-0.106***	-0.043	0.392***	1.000		
RSI	0.427***	0.545***	0.030	-0.240***	-0.089**	0.626***	0.124***	0.020	1.000	
VOLA	-0.330***	-0.566***	-0.187***	0.466***	0.075**	-0.356***	-0.384***	-0.107***	-0.481***	1.000

We first analyse the relation between the sentiment indicators and equity returns by regressing portfolio returns on the indicators. It can be seen that *AVDC, CEFD, MFI, PCV, RSI* and *VOLA* all have some explanatory power over the return series, especially for large and small stocks (Table 3). Overall, investor sentiment, as measured by these indicators, does have an identifiable impact on UK equity returns.

Table 3: Weekly regressions of returns on sentiment proxies

Table 3 shows the results of estimating equations of the following form:

$$R_{size} = \alpha_0 + \sum_{i=0}^{2} \beta_{1,i} AVDC_{t-i} + \sum_{i=0}^{2} \beta_{2,i} CEFD_{t-i} + \sum_{i=0}^{2} \beta_{3,i} MFI_{t-i} + \sum_{i=0}^{2} \beta_{4,i} PCV_{t-i} + \sum_{i=0}^{2} \beta_{5,i} PCO_{t-i} + \sum_{i=0}^{2} \beta_{6,i} RSI_{t-i} + \sum_{i=0}^{2} \beta_{7,i} VOLA_{t-i} + \sum_{i=0}^{2} \beta_{8,i} DVAR_{t-i} + \varepsilon_t$$

As there is some evidence of autocorrelation, the estimation method is OLS with Newey-West standard errors.

Variable definitions:

size = *big*, *mid* or *sml*; so, $\boldsymbol{R_{big}}$: return on the large-size stock portfolio; $\boldsymbol{R_{mid}}$: return on mid-size stock portfolio; $\boldsymbol{R_{small}}$: return on small-size stock portfolio; **AVDC**: Advances to declines ratio; **CEFD**: Closed-end Fund Discount; **MFI**: Money Flow Index; **PCV**: Put-call volume ratio; **PCO**: Put-call open interest ratio; **RSI**: Relative Strength Index; **VOLA**: Realized volatility; **DVRA**: first difference of Trading volume.

Adj-R^2: Adjusted R-squared; **S.E**: Standard Error of regression; **AIC**: Akaike information criterion.

	$\boldsymbol{R_{big}}$		$\boldsymbol{R_{mid}}$		$\boldsymbol{R_{sml}}$	
Variable	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**
$\boldsymbol{AVDC_t}$	3.4432***	12.9305	4.0788***	16.9843	2.7777***	13.1468
$\boldsymbol{AVDC_{t-1}}$	-0.2444	1.0828	-0.3132*	1.9511	0.1219	0.7094
$\boldsymbol{CEFD_t}$	0.8736***	5.9081	-0.1070	0.9711	-0.2897**	2.1221
$\boldsymbol{CEFD_{t-1}}$	-0.7786***	5.7406	0.2463**	2.4225	0.4053***	3.0120
$\boldsymbol{MFI_t}$	0.0077*	1.7532	0.0064*	1.7621	0.0086**	2.2920
$\boldsymbol{MFI_{t-1}}$	-0.0043	0.9901	-0.0010	0.2871	-0.0041	1.1311
$\boldsymbol{PCV_t}$	-0.4415**	2.5556	-0.0814	0.6431	0.0489	0.4187
$\boldsymbol{PCV_{t-1}}$	-0.0902	0.5667	0.0950	1.0732	0.1808*	1.8086
$\boldsymbol{PCO_t}$	1.5465	1.2046	0.3250	0.3455	0.4523	0.4743
$\boldsymbol{PCO_{t-1}}$	-1.5666	1.2389	-1.3249	1.4625	-1.3547	1.5182
$\boldsymbol{RSI_t}$	0.0067*	1.9095	0.0039	1.2023	0.0054*	1.9163
$\boldsymbol{RSI_{t-1}}$	-0.0094***	2.7588	-0.0045	1.4008	-0.0050	1.5960
$\boldsymbol{VOLA_t}$	-1.3277***	4.5117	-1.1671***	3.7928	-1.1919***	5.2281
$\boldsymbol{VOLA_{t-1}}$	0.6463*	2.4199	0.3758	1.4999	0.6600***	2.9629
$\boldsymbol{DVAR_t}$	0.0043	0.0037	-0.5206	0.5969	0.5249	0.6319
$\boldsymbol{DVAR_{t-1}}$	1.3602	1.2422	1.6919	1.5365	0.9365	0.7730
Adj-R^2	0.6070		0.6945		0.5978	
S.E	1.5504		1.3612		1.3522	
F-Statistic	74.2508		115.5267		63.9601	
AIC	3.7370		3.4755		3.4659	

It can be argued that financial market indicators provide the most "objective" indicators of investor sentiment, as they are most closely linked to measurable activity in the financial markets. However, financial market decisions can be driven by a combination of an asset's fundamentals and investor sentiment. Therefore, when using sentiment proxies to explain asset returns, it is not necessarily clear whether the explanatory power of the proxies comes from their fundamental or their sentimental component. The idea that financial market variables can be used as sentiment proxies is that they contain a factor corresponding to investor sentiment. The research consensus therefore is that this sentiment factor should be extracted from these proxy variables, rather than using the variables in their raw state. Brown and Cliff (2004) and Baker and Wurgler (2006) use the first principal component of several underlying sentiment proxies as their US investor

sentiment index. We construct our UK market sentiment index by applying the same method.

In the first stage, we calculate an *Index* by extracting the first principal component from 16 variables: the eight proxy variables and their one-period lags. According to Brown and Cliff (2004) and Baker and Wurgler (2006), the rationale for using current and lagged financial market data is that sentiment may be related to present information and also to the (recent) past, evolving somewhat in the manner of a filter, which the principal component method is intended to extract. In step two, we compute the correlation between *Index* and the current and lagged values of each of the proxies. Whichever has the higher correlation with the *Index* in each pair of current and lagged values is used in the final stage. At this stage, we define the sentiment index, *SENT*, as the first principal component of the correlation matrix of the eight variables selected from step two. This turns out to be:

$$SENT_t = 0.2128AVDC_{t-1} - 0.3655CEFD_t + 0.4044MFI_{t-1} + 0.3273PCO_t +$$

$$0.2128PCV_t + 0.4737RSI_t - 0.5169VOLA_{t-1} - 0.1165DVRA_{t-1} \quad \ldots(1)$$

The correlation between the 16-term $Index$ and the 8-term *SENT* is 0.98, indicating that little information is lost in dropping the eight terms with different time subscripts. *SENT* explains 32% of the sample variance suggesting that one factor captures a significant part of the common variation. *SENT* is interpreted as a measure of UK market-wide investor sentiment, since it is extracted from variables that are generally seen as broad indicators of investor sentiment.

We turn next to a sentiment index representing "informed" institutional investors. For this we argue that sentiment proxies related to derivatives trading are likely to be most representative of institutional sentiment because institutional investors are more likely to be dominant in the derivatives markets (Brown and Cliff, 2004). We use a subset of sentiment variables, *PCO*, *PCV* and *VOLA*, to construct the institutional sentiment index ($SENT^P$). Using the same method as for *SENT*, $SENT^P$ is given by:

$$SENT_t^P = 0.6492PCO_t + 0.5344PCV_t - 0.5412VOLA_{t-1} \quad \ldots(2)$$

The first principal component of $SENT^P$ explains 55% of the sample variance showing that one factor captures much of the common variation. However, since PCO_t, PCV_t and $VOLA_{t-1}$ are used in the construction of the market and institutional sentiment indices, this may lead to a problem of overlapping between the two indices. To examine this, a further index ($SENT^X$) is constructed by

excluding PCO_t, PCV_t and $VOLA_{t-1}$ from the calculation of *SENT*. This is:

$$SENT_t^X = 0.3742AVDC_{t-1} - 0.2743CEFD_t + 0.5682MFI_{t-1} + 0.6443RSI_t - 0.2163DVRA_{t-1} \quad \ldots(3)$$

The first principal component of $SENT^X$ explains 37% of the sample variance. The correlation coefficient between $SENT^X$ and *SENT* is 0.9997. The relation between the two indices is therefore very close to one-for-one. This suggests that irrespective of whether the market sentiment index is constructed including or excluding the three institutional proxies, the outcomes are very similar. We conclude that there is no problem of overlapping between the indices, *SENT* and $SENT^P$.

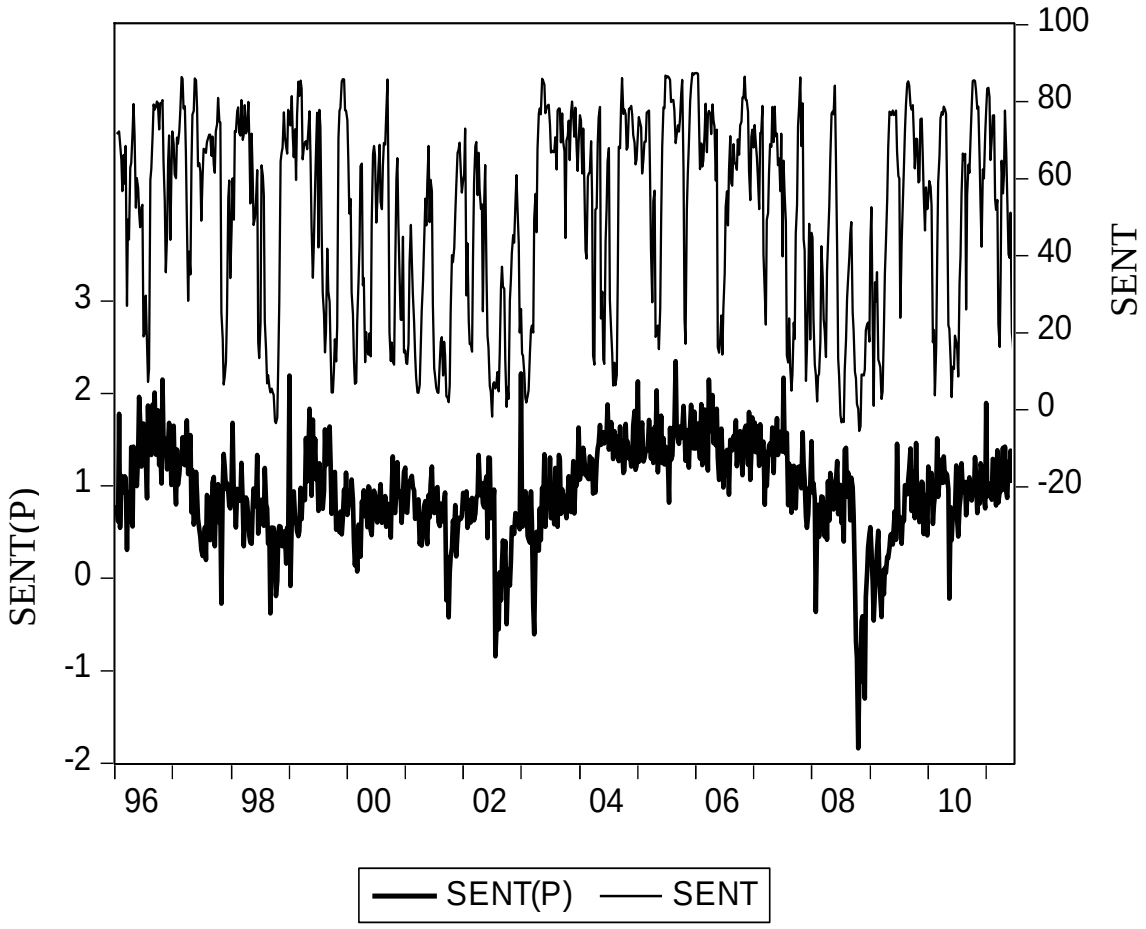

Figure 1: UK market investor sentiment index and institutional sentiment index, 1996 – 2011

The two sentiment indices, *SENT* and $SENT^P$, are both relatively persistent, but they are only moderately correlated with one another, suggesting that they do provide independent measures of investor sentiment. See Figure 1 and table 4. Table 4 also reports the correlation coefficients

between *SENT* and $SENT^P$ and the component proxy variables. $SENT^P$ has high correlation with all its components, and also has strong correlation with several non-component indicators, notably *CEFD*. *CEFD* is normally thought of as an indicator for individual investor sentiment rather than institutional sentiment. The higher correlation between *CEFD* and $SENT^P$ than between *CEFD* and *SENT* may be attributable to the importance of institutions in the UK market (Ammer, 1990). This echoes the correlation test result shown in Table 3, suggesting that CEFD has stronger correlation to the institutional sentiment, II, than to the individual sentiment, AAII. Apart from *CEFD*, *SENT* has a higher correlation with the pure market sentiment indicators (i.e. all except PCO_t, PCV_t, $VOLA_{t-1}$) than does $SENT^P$, and a lower correlation than $SENT^P$ with the institutional indicators: PCO_t, PCV_t, $VOLA_{t-1}$. This suggests that the components extracted for *SENT* and $SENT^P$ do capture sentiment from different groups of investors. Granger causality tests between *SENT* and $SENT^P$ (Table 4 Panel C) suggest that there is bi-directional causality and therefore no strong indication that either group of investors tends to lead market sentiment in the UK.

3. UK and foreign investor sentiment

As financial markets are internationally integrated, investor sentiment may be internationally correlated. Becjann et al. (2011) use survey-based indices whereas Baker et al. (2012) and Bai (2014) used composed indices to examine cross-border contagion of investor sentiment. Contagion may be due to common (international) information used in forming sentiment in different countries, or equally to investors' herding across borders. However, a change of sentiment in one country may lead to a change in another country regardless of how sentiment is measured in different countries. We therefore use the UK composed indices, *SENT* and $SENT^P$, and US survey- based indices, AAI and II, to investigate the relation between UK and US investor sentiment.

Table 4: Properties of UK Investor Sentiment Indices

Panel A reports summary statistics of the constructed investor sentiment indexes: UK market sentiment (SENT) and UK institutional sentiment (SNETP)
Panel B shows pairwise correlation coefficients.
Panel C shows p-values for the F statistics from bilateral Granger causality tests

Variable definitions:
SENT: UK market sentiment; **SENT^{P}**: UK institutional sentiment; **AVDC**: Advances to declines ratio; **CEFD**: Closed-end Fund Discount; **MFI**: Money Flow Index; **PCV**: Put-call volume ratio; **PCO**: Put-call open interest ratio; **RSI**: Relative Strength Index; **VOLA**: Realized volatility; **DVRA**: first difference of Trading volume.
ADF is the Augmented Dickey-Fuller test with a maximum of 52 lags.
***Statistical significance at 1% level; **Statistical significance at 5% level; *Statistical significance at 10% level.

Panel A: Statistical summary of Weekly sentiment indices											
Variable	**Mean**	**Std Dev.**	**Skewness**	**Kurtosis**	**Jarque-Bera**	**ADF**	**Autocorrelations at lags 1-5**				
							1	**2**	**3**	**4**	**5**
SENT	50.1432	26.1439	-0.4746	1.8324	76.1325***	-7.954***	0.872***	0.733***	0.595***	0.475***	0.356***
SENT^{P}	0.9436	0.5187	-0.8072	5.2046	251.3766***	-4.9581***	0.708***	0.686***	0.647***	0.632***	0.561***

Panel B: Investor sentiment correlation coefficients										
	SENT$_t$	***SENT$^{P}_t$***	***AVDC$_t$***	***CEFD$_t$***	***MFI$_t$***	***PCV$_t$***	***PCO$_t$***	***RSI$_t$***	***VOLA$_t$***	***DVAR$_t$***
AVDC$_{t-1}$	0.3112***	0.0912***	0.0046	-0.0278	0.2697***	-0.0623*	0.0102	0.3619***	-0.0618*	-0.2099***
CEFD$_t$	-0.2595***	-0.4659***	0.0694**	1	-0.1056***	-0.1742***	-0.2576***	-0.2413***	-0.0658*	0.4667***
MFI$_{t-1}$	0.8014***	0.2961***	0.0052	-0.1413***	0.8003***	0.0822**	0.1323***	0.5903***	-0.1294***	-0.3166***
PCV$_t$	0.0564	0.6808***	-0.0834**	-0.1742***	-0.0437	1	0.3932***	0.0182	-0.1118***	-0.1055***
PCO$_t$	0.1540***	0.6835***	0.0002	-0.2576***	0.1158***	0.3932***	1	0.1227***	-0.2040***	-0.3827***
RSI$_t$	0.9550***	0.3600***	0.0290	-0.2413***	0.6262***	0.0182	0.1227***	1	-0.1433***	-0.4810***
VOLA$_{t-1}$	-0.5283***	-0.8123***	-0.0393	0.5093***	-0.3466***	-0.1788***	-0.4020***	-0.5106***	0.1594***	0.8201***
DVAR$_{t-1}$	-0.1391***	-0.0767**	-0.0068	-0.0176	-0.1166***	-0.0651	-0.0103	0.1159***	1	0.0584*
SENT$_t$	1	0.3967***								

Panel C: Granger causality tests of SENT		
	SENT^{P}	
	SENT does not Granger Cause ***SENT^{P}***	***SENT^{P}*** does not Granger Cause ***SENT***
SENT	<0.0001	0.0072

Table 5: Correlation and Granger causality tests: UK and foreign investor sentiment

Panel A shows pairwise correlation coefficients among different sentiment indices.

Panel B shows p-values for the F statistics from bilateral Granger causality tests as between either of the UK indices (*SENT* or $SENT^P$) and any one of the US (*AAII* or *II*)

Test 1: H_0: Granger-noncausality from the US index to the UK index.

Test 2: H_0: Granger-noncausality from the UK index to the US index.

Variable definitions:
SENT is UK market sentiment; **$SENT^P$** is UK institutional sentiment;

AAII is American Association of Individual Investors index; **II** is American Investors Intelligence index.

***Significant at 1% level; **Significant at 5% level; *Significant at 10% level.

Panel A: Correlation tests				
	$SENT^P$	***SENT***	***AAII***	***II***
$SENT^P$	1.000000			
SENT	0.3967***	1.000000		
AAII	0.0850***	0.4113***	1.000000	
II	0.4352***	0.5554***	0.5066***	1.000000
Panel B: Granger causality tests				
	AAII		**II**	
	Test 1	**Test 2**	**Test 1**	**Test 2**
SENT	<0.0001	0.9058	<0.0001	0.4826
$SENT^P$	<0.0001	0.3161	<0.0001	0.4701

As an hypothesis, we would expect that home investors, whether institutions or individuals, have less knowledge about foreign markets than about home markets, and that they would therefore be more likely to pay attention to foreign institutional ("expert") sentiment than to general foreign market sentiment. However, it might also be argued that market sentiment is more easily observable than institutional sentiment. In fact, UK institutional sentiment ($SENT^P$) is more strongly correlated with US institutional sentiment (II) than with US individual sentiment (AAII); UK market sentiment (*SENT*) is also more highly correlated with II than with AAII (Table 5 panel A). Granger-causality tests (Table 5 panel B) provide strong evidence that AAII and II each Granger-cause *SENT* and $SENT^P$, but *SENT* and $SENT^P$ do not Granger-cause any of AAII and II. This clearly suggests that US investors' sentiment does tend to lead UK investor sentiment, but not vice versa.

Next we regress the UK sentiment indices on the US indices to investigate how far foreign investor sentiment directly affects UK investor sentiment. The basic model is:

$$SENT_t^K = \alpha_0 + \sum_{i=0}^{4} \gamma_i AAII_{t-i} + \sum_{i=0}^{4} \delta_i II_{t-i} + \sum_{i=1}^{4} \beta_i SENT_{t-i}^K + \varepsilon_t \quad \ldots (4)$$

Here, $SENT_t^K$ = UK market sentiment, or institutional sentiment (K=P).

The estimates (Table 6) suggest that UK institutional and market sentiment are both strongly persistent even when controlling for the impact of changes in foreign sentiment. Changes in US individual and institutional sentiment each have an immediate effect on both UK market and institutional sentiment. Both the signs and lag structures of these effects do however differ between the US effects within each equation, and for the same variable across equations. Tests of size of impact ($\gamma_i = \delta_i$) within equations suggest that there are differences between the size of impact of US individual and institutional sentiment. However, perhaps the most interesting feature of all these results is that there is strong evidence of an apparent partial reversal in the effect of foreign sentiment: a "second thoughts" effect. We can see this most clearly in the $SENT^P$ equation, where the current impact of AAII (γ_0) is –0.2811 while the lagged effect (γ_1) is +0.3704, producing a much smaller total effect of 0.0896. Of course, the level of sentiment cannot easily be normalised on any particular metric, and so the exact magnitude of any specific coefficient does not have a precise interpretation. It is the signs and relative magnitudes of coefficients on the same variable when compared across different lags that is of interest here. This can be interpreted as a reversal effect, perhaps reflecting second thoughts by home investors about changes in foreign sentiment. We can see that the sign reversals occur in all the foreign sentiment effects where the effect persists over more than a single week. Clearly, if the immediate impact of foreign sentiment changes is to induce UK investors to trade, then "second thoughts" may well induce trade reversals in the subsequent week(s), increasing UK stock market volatility as a result. In summary, foreign sentiment does have direct effects on UK sentiment, even after controlling for the autocorrelation in the sentiment variables themselves, and there appears to be a significant reversal or "second thoughts" component to these effects.

Table 6: Regression analysis of UK sentiment measures on foreign sentiment indices

Table 6 reports the results of estimating equations of the general form:

$$SENT_t^K = \alpha_0 + \sum_{i=0}^{4} \gamma_i AAII_{t-i} + \sum_{i=0}^{4} \delta_i II_{t-i} + \sum_{i=1}^{4} \beta_i SENT_{t-i}^K + \varepsilon_t$$

Insignificant variables were deleted from the model only where this did not produce unacceptable spikes in the estimated lag structure. The estimation method is OLS with Newey-West standard errors for residual serial correlation and heteroscedasticity.

Variable definitions:
SENT^K = UK market sentiment (K=M), or institutional sentiment (K=P); **AAII**: American Association of Individual Investors index; **II**: American Investors Intelligence index; Fi, i = 1,…,4, are F tests for the quantitative effects of US general and market sentiment: F1: $\gamma_1=\delta_1$; F2: $\gamma_0=\delta_0$; F3: $|\gamma_1|=\delta_1$; F4: $\gamma_2=\delta_2$
***Significant at 1% level; **Significant at 5% level; *Significant at 10% level.

SENT				***SENT^P***		
	Coef.	**t-Stat**			**Coef.**	**t-Stat**
$AAII_t$	7.5319**	2.3604		$AAII_t$	–0.2811***	3.7141
$AAII_{t-1}$	16.408***	5.0958		$AAII_{t-1}$	0.3704***	4.0184
$AAII_{t-2}$	–13.896***	4.1477		$AAII_{t-2}$	0.0523	0.6224
II_t	12.9537	1.2224		$AAII_{t-3}$	–0.1571*	1.7043
II_{t-1}	48.2156***	3.8502		$AAII_{t-4}$	0.0648	0.8513
II_{t-2}	–25.2721*	1.6831		II_t	0.5006***	3.1315
II_{t-3}	–6.5870	0.5107		$SENT^P_{t-1}$	0.3182***	6.4143
II_{t-4}	–24.2740***	3.0110		$SENT^P_{t-2}$	0.2301***	6.5695
$SENT_{t-1}$	0.8220***	44.681		$SENT^P_{t-3}$	0.1154***	3.2100
Adj. R^2	0.8078			$SENT^P_{t-4}$	0.1488***	3.4082
S.E.	11.4846			**Adj. R^2**	0.6209	
AIC	7.7323			**S.E.**	0.3204	
F1	6.3915***			**AIC**	0.5752	
F2	0.2010			**F1**		
F3				**F2**	15.850***	
F4	0.5387			**F3**	1.8852	

4. Investor sentiment and equity returns

To study the impact of sentiment on UK stock returns we classify UK Equities into three portfolios according to market capitalisation. The FTSE 100 Index is used to represent prices of the large stocks, and the return, R_{big}, computed accordingly. The FTSE 250 represents prices of mid-size stocks, with return, R_{mid}. The FTSE Small Cap Index is used for small stocks, with return, R_{sml}. Table 1 contains summary statistics for all these variables.

Table 3 shows that some of the UK sentiment proxies have statistically significant explanatory power over UK equity returns. However, *prima facie*, it is not clear whether this is due to the sentimental or fundamental components of the proxies. Since *SENT* and *SENT^P* are extracted

from these proxies, they are less likely to contain fundamental components and therefore to be a better representation of sentiment *per se*. Next therefore we study the relationship between UK equity returns and the indices of UK and foreign sentiment. We concentrate on US and UK sentiment to exploit the longer data sample and the distinction between US individual and investor sentiment.

Table 7: Correlation and Granger causality test for stock returns and investor sentiment

Panel A shows pairwise correlation coefficients between sentiment indices and different size UK stock portfolios. Panel B gives p-values for the F statistics from bilateral Granger causality tests as between the sentiment indices and the returns on different size UK stock portfolios.
Test 1: H_0: Granger-noncausality from stock returns to the sentiment index.
Test 2: H_0: Granger-noncausality from sentiment index to stock returns.

Variable definitions:
SENT: UK market sentiment; **SENT^P**: UK institutional sentiment; **AAII**: American Association of Individual Investors index; **II**: American Investors Intelligence index; **SENTIX**: German equity sentiment index. $\boldsymbol{R_{big}}$: return on the large-size stock portfolio; $\boldsymbol{R_{mid}}$: return on mid-size stock portfolio; $\boldsymbol{R_{small}}$: return on small-size stock portfolio.
***Significant at 1% level; **Significant at 5% level; *Significant at 10% level.

Panel A: Correlation tests						
	R_{big}		**R_{mid}**		**R_{sml}**	
SENT^P	-0.0094		0.0917***		0.2563***	
SENT	-0.0511		0.0015		0.0635*	
AAII	0.2059***		0.2629***		0.3403***	
II	0.1191***		0.2020***		0.2771***	
Panel B: Granger causality tests						
	R_{big}		**R_{mid}**		**R_{sml}**	
	Test 1	**Test 2**	**Test 1**	**Test 2**	**Test 1**	**Test 2**
SENT^P	<0.0001	0.8899	<0.0001	0.7713	<0.0001	0.8345
SENT	<0.0001	0.8747	<0.0001	0.4804	<0.0001	0.4306
AAII	<0.0001	0.6950	<0.0001	0.4628	<0.0001	0.2980
II	0.0001	<0.0001	0.0001	<0.0001	0.0167	<0.0001

Correlation tests for the returns on the three UK stock portfolios and for UK and US sentiment indices are shown in table 7. Strikingly, there is only limited evidence of any contemporaneous correlation between UK sentiment and UK stock returns, and that is for small and mid-sized stocks, but there is stronger evidence that UK returns are correlated with US sentiment for all three stock portfolios. Empirical studies of the bi-directional relation of investor sentiment and returns provide rather mixed suggestions. Some indicate that investor sentiment has strong predictive power over stock returns (Baker and Wurgler, 2006, Beaumont et al. 2005, Bandopadhyaya and Jones, 2008, Schmeling, 2009). Others show that sentiment itself is caused by returns (Subrahmanyan, 2005, Wang et al. 2006). Estimating bivariate VAR models, we test

for Granger-causality between sentiment and returns[6]. Bivariate Granger causality tests show that there is one-way causality from either UK or US sentiment to UK stock returns, irrespective of portfolio size. The only exception is US institutional sentiment, where there is bidirectional causality with all three stock portfolios. We turn next to formal regression models of UK returns on UK and US sentiment, beginning with UK sentiment: *SENT* and $SENT^P$.

4.1 UK investor sentiment and Equity returns

DeLong, et al (1990), Daniel et al (1998), and Odean (1998) suggest that psychological bias leads to noise traders' misperceptions that in turn cause asset price fluctuations. Overconfident investors overreact to private information and drive stock prices away from fundamentals, and confidence will be affected by feedback from the outcome. We therefore hypothesize that investor sentiment may have an immediate effect on stock returns, and stock returns may affect sentiment by the feedback effect. Brown and Cliff(2004) and Wang et al. (2006) show this feedback effect of stock returns in a VAR frame work. Granger causality (Table 7) also provides one test of this hypothesis.

Here, we consider a more general model of the impact of UK sentiment on UK stock returns. This includes both UK institutional and market sentiment and allows for a contemporaneous effect of sentiment on stock returns:

$$R_{size,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_j R_{size,t-j} + \sum_{i=0}^{n} \beta_i SENT_{t-i} + \sum_{i=0}^{n} \gamma_i SENT^{p}_{t-i} + \varepsilon_t \quad \ldots (5)$$

where *size* = *big*, *mid* or *sml*, and we begin with n=4 lags, testing down by deleting insignificant variables only where this does not produce unacceptable spikes in the estimated lag structure.

[6] Variable series are suggested to be stationary by ADF and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) method, ADF test statistics are reported in Table 1 and Table 4. KPSS test results are available by request.

Table 8: Regression of returns on UK sentiment indexes

Table 8 reports the results of regressions of the following general form:

$$R_{size,t} = \alpha_0 + \sum_{j=1}^{4} \alpha_j R_{size,t-j} + \sum_{i=0}^{2} \beta_i SENT_{t-i} + \sum_{i=0}^{2} \gamma_i SENT^{p}_{t-i} + \varepsilon_t$$

The estimation method is OLS with Newey-West standard errors for residual serial correlation and heteroscedasticity.

Variable definitions:

size = *big*, *mid* or *sml*; so, $\boldsymbol{R_{big}}$: return on the large-size stock portfolio; $\boldsymbol{R_{mid}}$: return on mid-size stock portfolio; $\boldsymbol{R_{small}}$: return on small-size stock portfolio; **SENT**: UK market sentiment; $\mathbf{SENT^P}$: UK institutional sentiment. $\bar{\mathbf{R}}^{\mathbf{2}}$: the Adjusted R-squared; **S.E**: Standard Error of regression; **AIC**: Akaike information criterion; LM: Breusch/Godfrey LM test for residual autocorrelation; **ARCH**: ARCH test for Heteroskadasticity. Fi, i = 1,…,3, are F tests for the quantitative effects of UK market sentiment and institutional sentiment: F1: $\beta_0 = \gamma_0$; F2: $\beta_1 = \gamma_1$; F3: $|\beta_1| = |\gamma_1|$

***Statistical significance at 1% level; **Statistical significance at 5% level; *Statistical significance at 10% level.

	$\boldsymbol{R_{big}}$		$\boldsymbol{R_{mid}}$		$\boldsymbol{R_{sml}}$	
	Coefficient	**t-Statistic**	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**
$\boldsymbol{\alpha_0}$	-0.1329	0.4055	-0.1109	0.3029	-0.3897	1.1355
$\boldsymbol{R_{t-1}}$	-0.1620***	2.0951			0.2378***	4.0842
$\boldsymbol{R_{t-2}}$	-0.0519	1.0510				
$\boldsymbol{R_{t-3}}$	-0.0253	0.5036				
$\boldsymbol{R_{t-4}}$	-0.0856*	1.7942				
$\boldsymbol{SENT_t}$	0.0234**	2.2361	0.0135**	1.9907	0.0205***	3.0320
$\boldsymbol{SENT_{t-1}}$	-0.0152*	1.6779	-0.0040	0.6409	-0.0084	1.5366
$\boldsymbol{SENT^P_t}$	-0.2932	0.7840	-0.0767	0.2104	-0.1804	0.7139
$\boldsymbol{SENT^P_{t-1}}$	0.0777	0.2171	0.2722	0.9230	0.4297*	1.8673
$\boldsymbol{SENT^P_{t-2}}$			-0.4350	1.4661	-0.4485*	1.9110
Adj. R^2	0.0129		0.0077		0.1208	
S.E.	2.4598		2.4548		1.9991	
AIC	4.6492		4.6414		4.2319	
LM	1.0819		1.6281***		1.6552***	
ARCH	55.0853***		55.0461***		39.9187***	
F1	0.7104		0.0613		0.6408	
F2	0.0673				3.5785*	
F3					3.3520*	

The results suggest that UK sentiment does have an effect on UK stock returns but the institutional effect is relatively weak (Table 8). Market sentiment clearly has a significant contemporaneous effect on the returns of all three size-based portfolios. However, the (just) significant effect of institutional sentiment is confined to small stocks. One might anticipate that institutional sentiment would have a stronger effect than market sentiment on smaller stocks, because institutions would be expected to have an information advantage for less well-known companies. However, in these results, the significant impact of institutional sentiment is confined exclusively to small stocks and, in any event, is less significant than market sentiment. We also see some evidence of "second thoughts", with coefficients on lagged sentiment having the opposite sign to those on current sentiment, although many of these reversals are barely significant.

To investigate these findings more closely, we pursue the argument that investor sentiment is more likely to influence decisions during periods of market stress, especially around times of financial crisis (Cooper, Gutierrez and Hameed, 2004), or economic crisis (Chung, Hung and Yeh, 2012). The sample period of 1996-2011 has experienced several major economic and financial crises. We investigate whether sentiment has a different effect in crisis times by dividing the sample into three sub-samples: non-crisis periods, pre-crisis periods, and in-crisis periods. See appendix 2 for full details of these sub-samples. We then regress portfolio returns on *SENT* and $SENT^P$ as before, using interacting dummies to identify separate slope coefficients for each sub-sample corresponding to the different market states of normal, pre-crisis and in-crisis (Table 9).

It can be seen that the effect of sentiment in this model is less uniformly significant, appearing at different lags within the different periods. There is continued evidence of sign-reversal in the time effects of sentiment, although several of these coefficients are not significant. It seems clear that sentiment has little significant impact on returns in crisis periods (apart from on small stocks), but does tend to be more significant in normal and more especially in pre-crisis periods. The pre-crisis periods when we find sentiment to have the most impact are those in which stock prices rose sharply on a wave of optimism corresponding to a bubble effect. Thus our results provide some support to some earlier findings that sentiment tends to have its strongest impact on stock prices during up-markets when investors are optimistic. The absence of sentiment effects during in-crisis periods is consistent with the thesis that a financial crisis is typically a process by which prices revert back to fundamentals as they are no longer driven by sentiment (Cooper, Gutierrez and Hameed, 2004; Chung, Hung and Yeh, 2012).

In a parallel manner we can investigate the impact of investor sentiment on stock returns under different market sentiment conditions. To do this, we define weeks of high sentiment as those when sentiment is above its sample mean ($SENT_t^K > \overline{SENT^K}$; $K = market\ or\ P$), or low sentiment when $SENT_t^K < \overline{SENT^K}$. We then regress our portfolio returns on *SENT* and $SENT^P$ once again, using interacting dummies to identify separate slope coefficients for each sub-sample corresponding to the different market sentiment conditions (Table 10). We see that market and institutional sentiment are never significant when overall market sentiment is low. However, when market sentiment is high, there is some evidence of an impact of sentiment: on large and to a lesser extent on small stocks. As sentiment tends to be greater in up-markets these results provide further, indirect, support for the argument that sentiment matters more in rising markets.

Table 9: Regression of returns on UK sentiment indexes under financial crisis conditions

Table 9 reports the results of regressions of the following form:

$$R_{size,t} = \alpha_1^1 D_1 + \alpha_2^1 R_{size,t-1} * D_1 + \sum_{i=0}^{2} \beta_i^1 SENT_{t-i} * D_1 + \sum_{i=0}^{2} \gamma_i^1 SENT_{t-i}^{p} * D_1 + \alpha_1^2 D_2 + \alpha_2^2 R_{t-1} * D_2 + \sum_{i=0}^{2} \beta_i^2 SENT_{t-i} * D_2 + \sum_{i=0}^{2} \gamma_i^2 SENT_{t-i}^{P} * D_2 + \alpha_1^3 D_3 + \alpha_2^3 R_{t-1} * D_3 + \sum_{i=0}^{2} \beta_i^3 SENT_{t-i} * D_3 + \sum_{i=0}^{2} \gamma_i^3 SENT_{t-i}^{p} * D_3 + \varepsilon_t$$

The estimation method is OLS with Newey-West standard errors for residual serial correlation and heteroscedasticity.

Variable definitions:

size = *big*, *mid* or *sml*; so, $\boldsymbol{R_{big}}$: return on the large-size stock portfolio; $\boldsymbol{R_{mid}}$: return on mid-size stock portfolio; $\boldsymbol{R_{small}}$: return on small-size stock portfolio; **SENT**: UK market sentiment; $\mathbf{SENT^P}$: UK institutional sentiment. $D_1 = 1$ in non-crisis periods and zero otherwise; $D_2 = 1$ in pre-crisis periods and zero otherwise; $D_3 = 1$ in in-crisis periods and zero otherwise. The pre- and in-crisis periods are as defined in Appendix 2. The no-crisis periods consist of the remaining observations in the sample. The total number of observation is 809: 183 weeks fall in pre-crisis period, 147 weeks are in-crisis and 479 weeks are normal.

T statistics are shown in parentheses. Fi, i = 1,…,3, are F tests for the quantitative effects of UK market sentiment and institutional sentiment: F1: $\beta_0 = \gamma_0$; F2: $\gamma_2 = \beta_2$; F3: $\beta_1 = \gamma_1$. ***Statistical significance at 1% level; **Statistical significance at 5% level; *Statistical significance at 10% level.

	R_{big}			R_{mid}			R_{sml}		
	Normal period	**pre-crisis period**	**in-crisis period**	**Normal period**	**pre-crisis period**	**in-crisis period**	**Normal period**	**pre-crisis period**	**in-crisis period**
α_1	-0.0918 (0.2482)	1.7738*** (3.2219)	1.1782 (1.3790)	-0.2892 (0.6369)	1.4424** (2.3399)	0.7117 (0.8129)	-0.5482 (1.1786)	0.9451 (1.5912)	0.3679 (0.5281)
R_{t-1}	-0.1228 (1.2993)	-0.1577** (1.9680)	-0.2925** (2.1323)	-0.0161 (0.2090)	0.2290** (2.4943)	-0.1325 (1.6151)	0.1892** (2.4600)	0.3737*** (3.4853)	0.2879*** (3.4333)
$SENT_t$	0.0148 (1.1644)	0.0095 (0.6973)	0.0324 (1.5041)	0.0201* (1.6757)	-0.0232* (1.7826)	0.0156 (0.9537)	0.0311*** (3.2240)	-0.0055 (0.5747)	0.0020 (0.1381)
$SENT_{t-1}$	-0.0229 (1.6053)	-0.0029 (0.1966)	-0.0227 (0.9496)	-0.0205 (1.4786)	0.0414** (2.5095)	-0.0049 (0.2098)	-0.0199** (1.9677)	0.0136 (1.2098)	0.0123 (0.6089)
$SENT_{t-2}$	0.0146* (1.6692)	-0.0160 (1.5282)	-0.0230 (1.6316)	0.0141 (1.5445)	-0.0230** (2.1772)	-0.0183 (1.0649)	0.0041 (0.5885)	-0.0090 (0.9634)	-0.0155 (1.1190)
$SENT^P_t$	-0.0857 (0.1650)	-0.9260** (2.2148)	-0.9462 (1.1341)	0.2254 (0.4543)	-0.5125 (1.2354)	-0.7694 (1.2070)	0.0561 (0.1640)	-0.4181 (1.1464)	-0.9314* (1.8576)
$SENT^P_{t-1}$	0.0262 (0.0515)	-0.1437 (0.3167)	-0.4246 (0.4236)	0.4773 (1.1717)	-0.8106* (1.7775)	-0.0048 (0.0082)	0.5732* (1.7441)	-0.3880 (1.2523)	0.2731 (0.5752
$SENT^P_{t-2}$	-0.1428 (0.3153)	0.3279 (0.7739)	0.1827 (0.3329)	-0.9180** (1.9791)	0.5483 (1.4453)	-0.2471 (0.5195)	-0.7901** (2.2030)	0.2191 (0.6760)	-0.2912 (1.2912)
F1				0.1708	1.3727		0.0054		3.4987*
F2	0.1201			4.0034**	2.2241		4.8884**		0.6862
F3					3.3725*		3.2096**		0.2980

Table 10: Regression of returns on UK sentiment indexes under different market sentiment conditions s

Table 10 reports the results of regressions of the following general form:

$$R_{size,t} = \alpha_1^1 D_1 + \alpha_2^1 R_{size,t-1} * D_1 + \sum_{i=0}^{2} \beta_i^1 SENT_{t-i} * D_1 + \sum_{i=0}^{2} \gamma_i^1 SENT_{t-i}^{p} * D_1 + \alpha_1^2 D_2 + \alpha_2^2 R_{t-1} * D_2 + \sum_{i=0}^{2} \beta_i^2 SENT_{t-i} * D_2 + \sum_{i=0}^{2} \gamma_i^2 SENT_{t-i}^{P} * D_2 + \alpha_1^3 D_3 + \alpha_2^3 R_{t-1} * D_3 + \sum_{i=0}^{2} \beta_i^3 SENT_{t-i} * D_3 + \sum_{i=0}^{2} \gamma_i^3 SENT_{t-i}^{p} * D_3 + \varepsilon_t$$

The estimation method is OLS with Newey-West standard errors for residual serial correlation and heteroscedasticity.

Variable definitions:

size = big, mid or *sml*; so, $\boldsymbol{R_{big}}$: return on the large-size stock portfolio; $\boldsymbol{R_{mid}}$: return on mid-size stock portfolio; $\boldsymbol{R_{small}}$: return on small-size stock portfolio; **SENT**: UK market sentiment; $\mathbf{SENT^P}$: UK institutional sentiment. $D_1 = 1$ when $SENT_t > \overline{SENT}$ and zero otherwise; $D_2 = 1$ when $SENT_t < \overline{SENT}$ and zero otherwise.

Fi, i = 1,…,3, are F tests for the asymmetric effects of UK market sentiment and institutional sentiment: in different market conditions. F1: $\beta_0^1 = \beta_0^2$, where β_0^1 is β_0 when $SENT_t > \overline{SENT}$ and β_0^2 is β_0 when $SENT_t < \overline{SENT}$. F2: $\beta_1^1 = \beta_1^2$, where β_1^1 is β_1 when $SENT_t > \overline{SENT}$ and β_1^2 is β_1 when $SENT_t < \overline{SENT}$. F3: $\gamma_2^1 = \gamma_2^2$, where γ_2^1 is γ_2 when $SENT_t > \overline{SENT}$ and γ_2^2 is γ_2 when $SENT_t < \overline{SENT}$. Fj, i = 4,…,6, are F tests for the quantitative effects of UK market sentiment and institutional sentiment when market sentiment is high: F4: $\beta_0^1 = \gamma_0^1$; F5: $\beta_1^1 = \gamma_1^1$; F6: $\beta_2^1 = \gamma_2^1$.

***Statistical significance at 1% level; **Statistical significance at 5% level; *Statistical significance at 10% level.

	R_{big}				R_{mid}				R_{sml}			
	$SENT_t > \overline{SENT}$		$SENT_t < \overline{SENT}$		$SENT_t > \overline{SENT}$		$SENT_t < \overline{SENT}$		$SENT_t > \overline{SENT}$		$SENT_t < \overline{SENT}$	
	Coef.	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**
α_0	0.1472	0.2204	0.1188	0.3115	0.2389	0.3457	-0.1635	0.3483	0.0881	0.1591	-0.5095	0.9801
R_{t-1}	-0.2272***	3.0123	-0.1065	1.0421	-0.1212	1.4419	0.0488	0.6354	0.1748*	1.8236	0.2623***	2.7158
$SENT_t$	0.0288**	2.1894	0.0124	0.6580	0.0208	1.3402	0.0096	0.5745	0.0212*	1.8084	0.0231	1.4938
$SENT_{t-1}$	-0.0292***	2.6762	-0.0089	0.5632	-0.0142	1.0270	-0.0006	0.0411	-0.0156	1.6162	-0.0028	0.2122
$SENT_{t-2}$	0.0047	0.6118	-0.0012	0.1225	0.0014	0.1739	0.0028	0.2504	0.0029	0.4549	-0.0034	0.3842
$SENT^P_t$	-0.5775	1.5870	-0.2502	0.3997	-0.3545	1.0887	0.0689	0.1222	-0.2650	1.1075	-0.2107	0.4862
$SENT^P_{t-1}$	-0.0112	0.0269	0.0736	0.1005	0.2868	1.0470	0.2626	0.4765	0.2417	1.1036	0.6011	1.5401
$SENT^P_{t-2}$	0.2973	1.0903	0.0086	0.0157	-0.3350	1.1942	-0.5450	1.0521	-0.3640*	1.6697	-0.5090	1.2648
F1	0.5357				0.2593				0.0098			
F2	1.1862											
F3									0.1013			
F4	2.7873*								1.4026			
F5	0.0019								1.3605			
F6	1.1427								2.8191*			

4.2 UK Equity returns and foreign investor sentiment

In the final section we look more directly at the impact of US sentiment on UK stock returns. We regress the portfolio returns on US and UK sentiment indexes:

$$R_{size,t} = \alpha_0 + \sum_{j=1}^{4} \alpha_j R_{size,t-j} + \sum_{i=0}^{4} \beta_i SENT_{t-i} + \sum_{i=0}^{4} \gamma_i SENT_{t-i}^{P} + \sum_{i=0}^{4} \delta_i AAII_{t-i} + \sum_{i=0}^{4} \theta_i II_{t-i} + \varepsilon_t \ldots (6)$$

The results seem to us to be striking (Table 11). First, once AAII and II are included in the regressions both UK sentiment variables become insignificant. This is true for all three portfolios: small, mid-size and large. This suggests that, although UK sentiment has a proximate influence on UK stock returns, it is not the ultimate source of that influence. To identify a more fundamental source we turn to the coefficients on US sentiment. Here we see that US individual sentiment is strongly significant in helping to explain the returns on all three portfolios: small, mid-size and large. US institutional sentiment is also highly significant in explaining the returns on all three portfolios, although the lag structure of the significant coefficients is one or two weeks longer than for the effects of US individual sentiment. However, US institutional sentiment appears to have a larger quantitative impact than does US individual sentiment. These results, together with those reported above for Granger causality and the returns regressions including only UK sentiment, strongly suggest that the effect that UK sentiment has on UK stock returns is largely driven by US investor sentiment. That is, UK stock returns are influenced by UK investor sentiment only to the extent that UK sentiment is itself moved by US sentiment. UK sentiment does not have an impact on returns that is independent of the effects that are transmitted *via* US investor sentiment. In other words we can say that, in our sample, UK investor sentiment is "born in the USA".

A further striking feature of this last set of results is the presence of sign reversals among the coefficients of all the sentiment measures. These reversals are consistent with the argument that sentiment contributes directly to volatility in portfolio returns: if buoyant sentiment contributes to increased returns in any given week this tends to be followed by reduced returns in the succeeding week(s).

Table 11: Regression of returns on UK and US sentiment indexes

Table 11 reports the results of regressions of the following general form:

$$R_{size,t} = \alpha_0 + \sum_{j=1}^{4} \alpha_j R_{size,t-j} + \sum_{i=0}^{4} \beta_i SENT_{t-i} + \sum_{i=0}^{4} \gamma_i SENT^{P}_{t-i} + \sum_{i=0}^{4} \delta_i AAII_{t-i} + \sum_{i=0}^{4} \theta_i II_{t-i} + \varepsilon_t$$

The estimation method is OLS with Newey-West standard errors for residual serial correlation and heteroscedasticity.

Variable definitions:

size = *big*, *mid* or *sml*; so, $\boldsymbol{R_{big}}$: return on the large-size stock portfolio; $\boldsymbol{R_{mid}}$: return on mid-size stock portfolio; $\boldsymbol{R_{small}}$: return on small-size stock portfolio; **SENT**: UK market sentiment; $\mathbf{SENT^P}$: UK institutional sentiment; ; **AAII**: American Association of Individual Investors index; **II**: American Investors Intelligence index.

R^2: Adjusted R-squared; S.E: Standard Error of regression; AIC: Akaike information criterion. LM: Breusch/Godfrey LM test for residual autocorrelation; ARCH: ARCH test for Heteroskadasticity.

Fi, i = 1,…,3, are F tests for the quantitative effects of market sentiment and institutional sentiment: F1: $\delta_0 = \theta_0$; F2: $\delta_1 = \theta_1$; F3: $\delta_2 = \theta_2$.

***Statistical significance at 1% level; **Statistical significance at 5% level; *Statistical significance at 10% level.

	$\boldsymbol{R_{big}}$		$\boldsymbol{R_{mid}}$		$\boldsymbol{R_{sml}}$	
	Coefficient	**t-Statistic**	**Coefficient**	**t-Statistic**	**Coefficient**	**t-Statistic**
$\boldsymbol{\alpha_0}$	-0.4475	1.5391	-0.2855	0.8792	-0.3225	1.0527
$\boldsymbol{R_{t-1}}$	-0.2322***	4.3521			0.1740***	3.5123
$\boldsymbol{R_{t-2}}$	-0.1153**	2.5633			0.0979**	2.3197
$\boldsymbol{R_{t-3}}$	-0.0971**	2.3805			0.1078	1.5603
$\boldsymbol{R_{t-4}}$	-0.1017**	2.2285			-0.0765*	1.8243
$\boldsymbol{SENT_t}$	0.0064	1.2066	0.0008	0.2207	0.0036	0.9739
$\boldsymbol{SENT^P_t}$	-0.0586	0.2520	-0.1351	0.5927	-0.0875	0.3886
$\boldsymbol{SENT^P_{t-1}}$					0.2257	1.0650
$\boldsymbol{SENT^P_{t-2}}$					-0.3293	1.5352
$\boldsymbol{AAII_t}$	4.0103***	6.0382	3.8361***	5.1932	3.1935***	5.4831
$\boldsymbol{AAII_{t-1}}$	-3.3533***	5.7636	-3.1409***	4.2974	-2.0525***	3.2092
$\boldsymbol{AAII_{t-2}}$					-1.4408**	2.2948
$\boldsymbol{AAII_{t-3}}$					1.1020*	1.8083
$\boldsymbol{II_t}$	13.6888***	6.8353	11.8334***	6.2330	7.5338***	4.8302
$\boldsymbol{II_{t-1}}$	-6.7411**	2.0047	-4.1114	1.2605	-0.1842	0.0763
$\boldsymbol{II_{t-2}}$	-1.8130	0.7303	-5.3677**	2.4268	-5.9423***	2.9877
$\boldsymbol{II_{t-3}}$	0.0155	0.0056				
$\boldsymbol{II_{t-4}}$	-4.0696**	2.5140				
$\mathbf{R^2}$	0.1831		0.1564		0.2474	
S.E.	2.2388		2.2662		1.8560	
AIC	4.4670		4.4840		4.0945	
LM	1.3500*		1.7945***		1.1823	
ARCH	57.3004***		60.2359***		18.8388***	
F1	18.9172***		18.9172***		4.7956**	
F2	0.9652		0.9652		3.3055*	
F3					8.1400***	

5. Conclusions

The goal of this paper was to investigate the effect of foreign and local components of investor sentiment on UK equity returns. First, we construct two new indices to measure UK market-wide and institutional investor sentiment. The UK market-wide index is not the first such index for the UK, but it is more comprehensive and at a higher frequency than previous such indices. Our UK institutional index is one of the very few composed indices which directly measure institutional investor sentiment distinct from the market and it is the first such for the UK. Second, we examine the relationship between UK composed sentiment indices on one hand and US survey-base investor sentiment on the other. We find that UK sentiment is Granger-caused by US sentiment, but not the reverse. It also suggests that if different sentiment factors are caught by different methods, they also pass through the border due to the herding instinct of noise traders. Third, we study the impact of UK and US sentiment on UK stock returns across different market states. Here we find several interesting results. First, sentiment tends to be a more important determinant of stock returns outside crisis periods. This is consistent with previous evidence that, in a financial crisis, prices revert back to fundamentals as they are no longer driven by sentiment. Second, we find pervasive evidence of "second thoughts" or return reversals in the impact of sentiment on returns. If a particular shock to sentiment is currently associated with increased returns, *ceteris paribus*, then its effect in the subsequent week(s) is to reduce returns. This provides tentative evidence for the argument that sentiment-driven returns may be volatile on a small scale as well as in the large in connection with the sources of financial crises. Fourth we find that when US and UK sentiment are used in the same regressions to explain UK stock returns, US sentiment drives out UK sentiment: US sentiment variables are highly significant whereas UK sentiment variables are not significant at all. This would suggest that UK sentiment may be "born in the USA".

Appendix 1: Definition of the UK sentiment proxies

Advances-Declines Ratio (AVDC): This is usually thought of as a "Market Strength" indicator, and is given by the ratio of the number of rising stocks rising to the number of declining stocks in the market. Brown and Cliff (2004) and Wang, Keswani and Taylor (2006) use a modification of AVDC as a sentiment proxy to construct their investor sentiment index.

Closed-end Fund Discount (CEFD): The CEFD is one of the earliest indicators of market sentiment (Lee, Shleifer and Thaler, 1991) and it has been widely used as a proxy to measure investor sentiment, for example, Brown, 1999, Brown & Cliff, 2004, and Baker & Wurgler, 2006. We calculate the discount from 129 closed-end investment trusts listed on the London Stock Exchange, using daily prices and Datastream-estimated Net Asset Values (NAV). The value-weighted discount of Lee *et al* (1991) is applied for the computation. They constructed a value-weighted index of discounts (CEFD):

$$CEFD_t = \sum_{i=1}^{n_t} W_i DISC_{it}$$

where: $W_i = \frac{NAV_{it}}{\sum_{i=1}^{n_t} NAV_{it}}$, $NAV_{it} = net\ asset\ value\ of\ fund\ i\ at\ end\ of\ period\ t$

$$DISC_{it} = \frac{NAV_{it} - SP_i}{NAV_{it}} \times 100,\ SP_i = stock\ price\ of\ fund\ i\ at\ end\ of\ period\ t$$

and n_t is the number of funds with available $DISC_{i,t}$ and $NAV_{i,t}$ data at the end of period t.

Money Flow Index (MFI): The MFI is a momentum indicator measuring the strength of money going in and out of a security, showing whether the security is overbought or oversold (Chen, Chong, and Duan, 2010). We begin with the "typical price" (TP) defined as:

$$TP_t = \frac{P_t^h + P_t^l + P_t^c}{3}$$

where, P_t^h is the highest price at t,, P_t^l is the lowest price, and P_t^c is the closing price. The money flow is then defined as: $Money\ Flow = Typical\ Price \times Turnover$. If $TP_t > TP_{t-1}$ then the money flow at time t is considered positive. The total money flow over the previous N periods (N = 5 in this study) is calculated as:

$$MFI_t = 100 \times \frac{Positive\ Money\ Flow_t}{Positive\ Money\ Flow_t + Negative\ Money\ Flow_t}$$

Put-call Volume ratio (PCV): The put-call trading volume is one of the most popular indicators of investor sentiment (Brown and Cliff, 2004). It is defined as the ratio of the trading volume of put options to the trading volume of call options, i.e. $PCV = \frac{volume_{put}}{volume_{call}}$. We calculate the PCV for the UK using FTSE100 index option put and call trading volumes.

Put-call Open Interest ratio (PCO): Wang, Keswani, & Taylor (2006) suggested that option open interest is more likely to be a better predictor of volatility than PCV, and therefore a better measure of investor sentiment. For the UK we computed PCO, from the FTSE100 index option as the ratio of put open interest to call open interest.

Relative Strength Index (RSI): RSI is widely used as a market indicator showing whether the market is oversold or overbought (Chen, Chong, and Duan, 2010). The market is thought to be overbought when RSI exceeds 80, and oversold when it is less than 20. The RSI is defined as:

$$RSI_t = 100 \times \frac{\sum_{i=1}^{n}(P_{t-1}-P_{t-i-1})_+}{\sum_{i=1}^{n}|P_{t-1}-P_{t-i-1}|}$$

where P_t is the price at time t; $(P_{t-1} - P_{t-i-1})_+ = P_{t-1} - P_{t-i-1}$ if $P_{t-1} - P_{t-i-1} > 0$, otherwise $(P_{t-1} - P_{t-i-1})_+ = 0$. We use n = 14 to calculate the RSI in this paper.

Realized volatility (VOLA): Brown and Cliff (2004) use realized volatility calculated from Open-High-Low-Close data to construct a sentiment indicator. The realized volatility measure used in this study is calculated using the extreme value method of Parkinson (1980), based on the daily high and low of the FTSE100 index future price. High VOLA indicates a low investor sentiment.

Trading Volume (VRA): Baker and Stein (2004) argue that market confidence is related to liquidity and that trading volume is a noisy measure of liquidity. We follow Baker and Wurgler (2006) and use:

$$VRA_t = 100 \times \frac{VOLMA5_t}{VOLMA50_t}$$

where $VOLMA5_t$ is the average turnover for the past 5 periods, and $VOLMA50$ is the average turnover for the past 50 periods.

Appendix 2: Definition of crisis event periods

There are four crisis periods defined as from a starting date; the period prior to this date is the pre-crisis period; the crisis period follows from the starting date, and then reversion to normal. The start of each crisis is dated by a combination of big events indicating market instability and the effects starting to have a significant impact on UK market price. The Asian crisis starts on 17th October 1997, when the new Taiwan dollar was devalued and the Hong Kong dollar was attacked again. The Hang Seng index fell 23% in three days and the FTSE350 fell nearly 10% in the next two weeks. The Russian crisis starts on 20th July 1998, when Russia raised the interest rate to over 100%. The FTSE350 reached a high of 2972.3, and then fell nearly 25% over the next 2½ months to 2239.1. The Dotcom bubble crash date is 10th March 2000, when the technology-heavy NASDAQ Composite index peaked at 5048.62 and then fell by over 70% in the next 2 years. The 2007-8 Global financial crisis is dated at 19th July 2007, when the Dow Jones Industrial Average closed above 14000 for the first time in its history and then fell by more than 36% over the following 1½ years.

Crisis	**Pre-Crisis Period**	**In-Crisis Period**
Asian Financial Crisis	17/10/1996-16/10/1997	17/10/1997-30/01/1998
Russian Financial Crisis	02/02/1998-20/07/1998	20/07/1998-29/01/1999
Dotcom bubble & crash	10/03/1999-09/03/2000	10/03/2000-09/03/2001
2007-8 Global Financial Crisis	19/07/2006-17/07/2007	19/07/2007-18/07/2008

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