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News and narratives in financial Systems

Exploiting big data for systemic risk assessment

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News and narratives in financial systems

Agenda

- Background & Objectives
- Data
- Relative Sentiment Shifts
 - Methodology
 - Results
- Narrative Consensus
 - Methodology
 - Results
- Summary



Background

- We recognise that narratives and emotions are key drivers behind economic and financial activity (e.g., Akerlof & Shiller, 2009; Tuckett, 2011)
 - Within the context of *radical uncertainty*, agents act by gaining conviction through the use of narratives
 - Such *conviction narratives* (Chong & Tuckett, 2014) must have emotional support to be acted upon – excitement about gain, suppressing doubt and anxiety about loss
 - Due to social interaction narratives may spread ‘systemically’
 - *Shifts* towards hot dotcoms, structured finance, tapering, cyber risk, etc.
- We recognise that financial markets can be *homogenised* because of a search for yield with *top performers as the benchmark* (Aikman et. al., 2011) - “*keeping up with the Goldmans*”



Objectives

- With big text data and modern machine learning techniques, there are new possibilities to investigate the effect of narratives on the economy and financial markets
- This research attempts to address *two key questions*
 - Can we measure *shifts in relative sentiment*?
 - If so, how does the measure relate to economic confidence, financial exuberance and stability?
 - Can we measure structural shifts in the *distribution of narratives*?
 - In particular, can we measure '*narrative consensus*' (homogenisation)
- We provide evidence of *increasing narrative consensus high in excitement and lacking anxiety*, leading up to the crisis, likely to be an important warning sign of impending distress



News and narratives in financial systems

Data

Data	Range	Description	Abbreviation
Internal Market Commentary	January 2000 through July 2010	Daily comments on market events	MCDAILY
Broker Circulars (Macro view)	January 2008 through June 2013	Low volume prior to June 2010. Primarily weekly economic research reports	BROKER
Reuters News London	January 2003 through July 2013	Reuters news published in London	RTRS



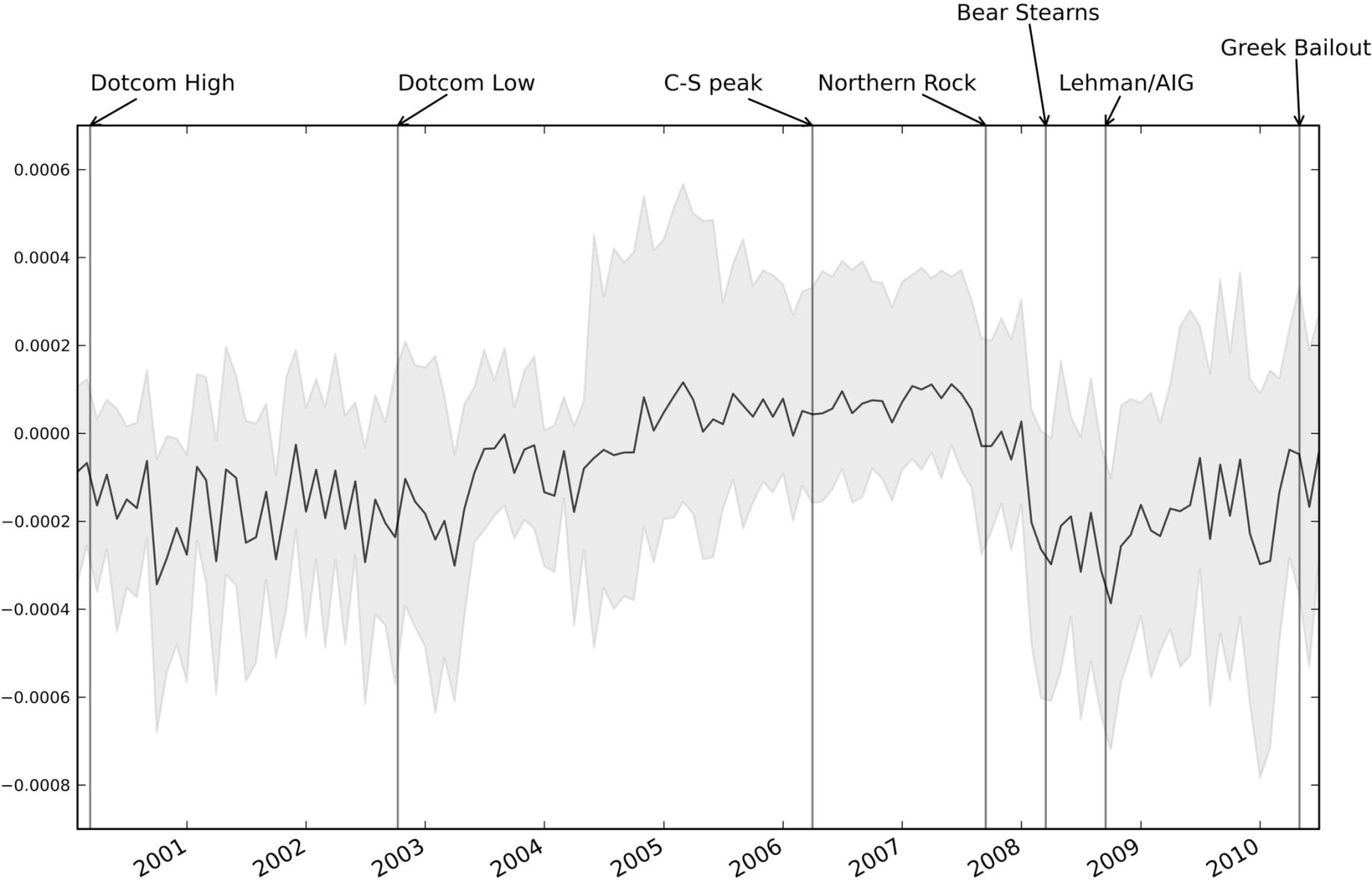
Relative Sentiment – Methodology

- Relative Sentiment Shifts
 - Theoretically motivated (and validated) word dictionaries are used
 - Excitement ~ 150 words, Anxiety ~ 150 words
 - *Relative sentiment metric* = (|excitement| - |anxiety|) / |characters|
 - Simplicity → more robust to data source, reduced complexity
- Excitement/Anxiety word samples
 - Amaze, amazed, amazes, amazing, attract, attracted, attraction, etc.
 - Anxiety, anxious, avoid, avoids, bother, bothers, bothered, etc.
- Bootstrap confidence intervals
 - Sample new weights for each word (weights sum to ~ 150)
 - Get a new sentiment point, repeat to get a distribution
 - Extract confidence intervals from the distribution



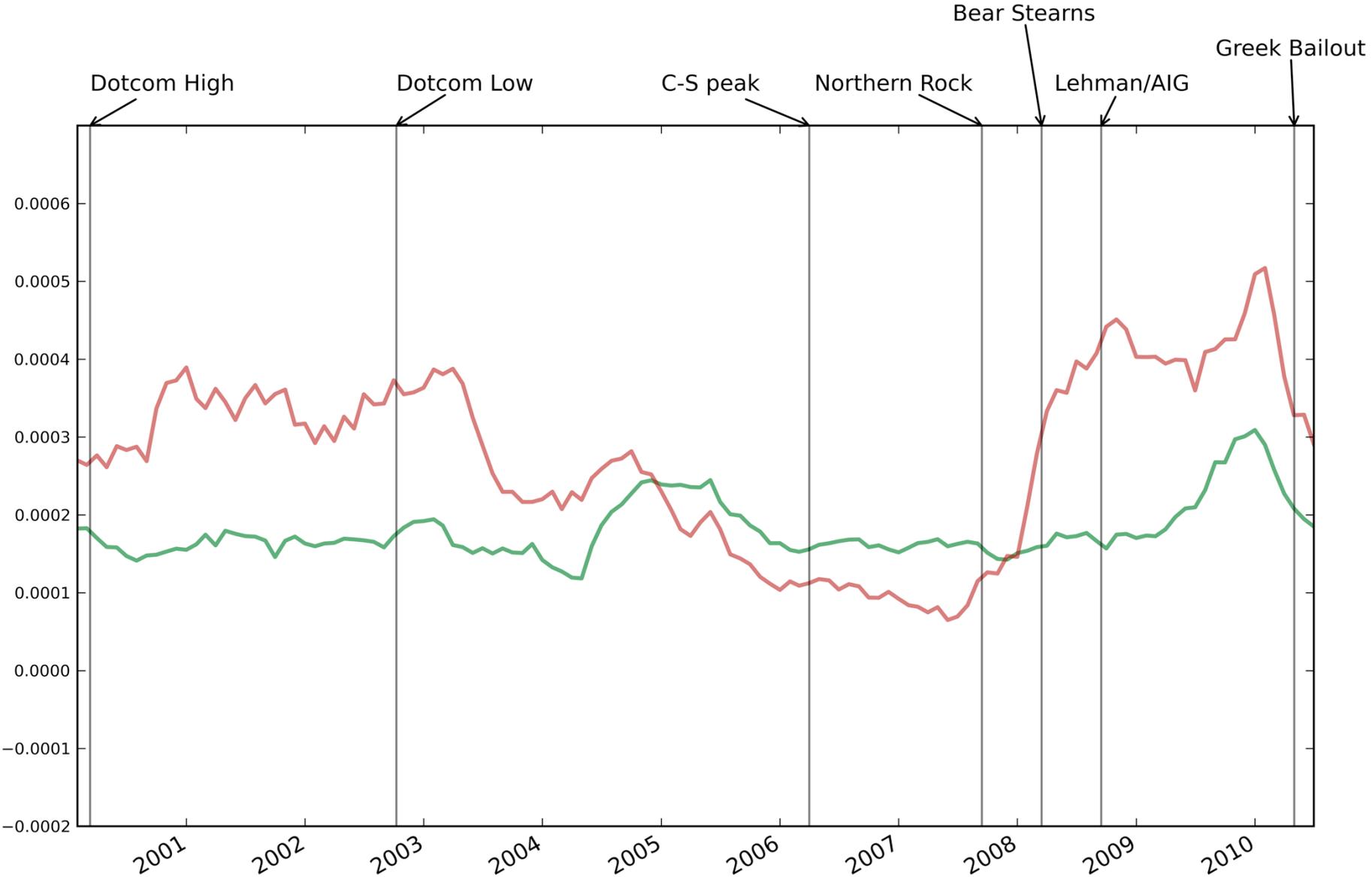
Internal Market Commentary (MCDAILY) – relative sentiment shifts

Consistent with historically significant events



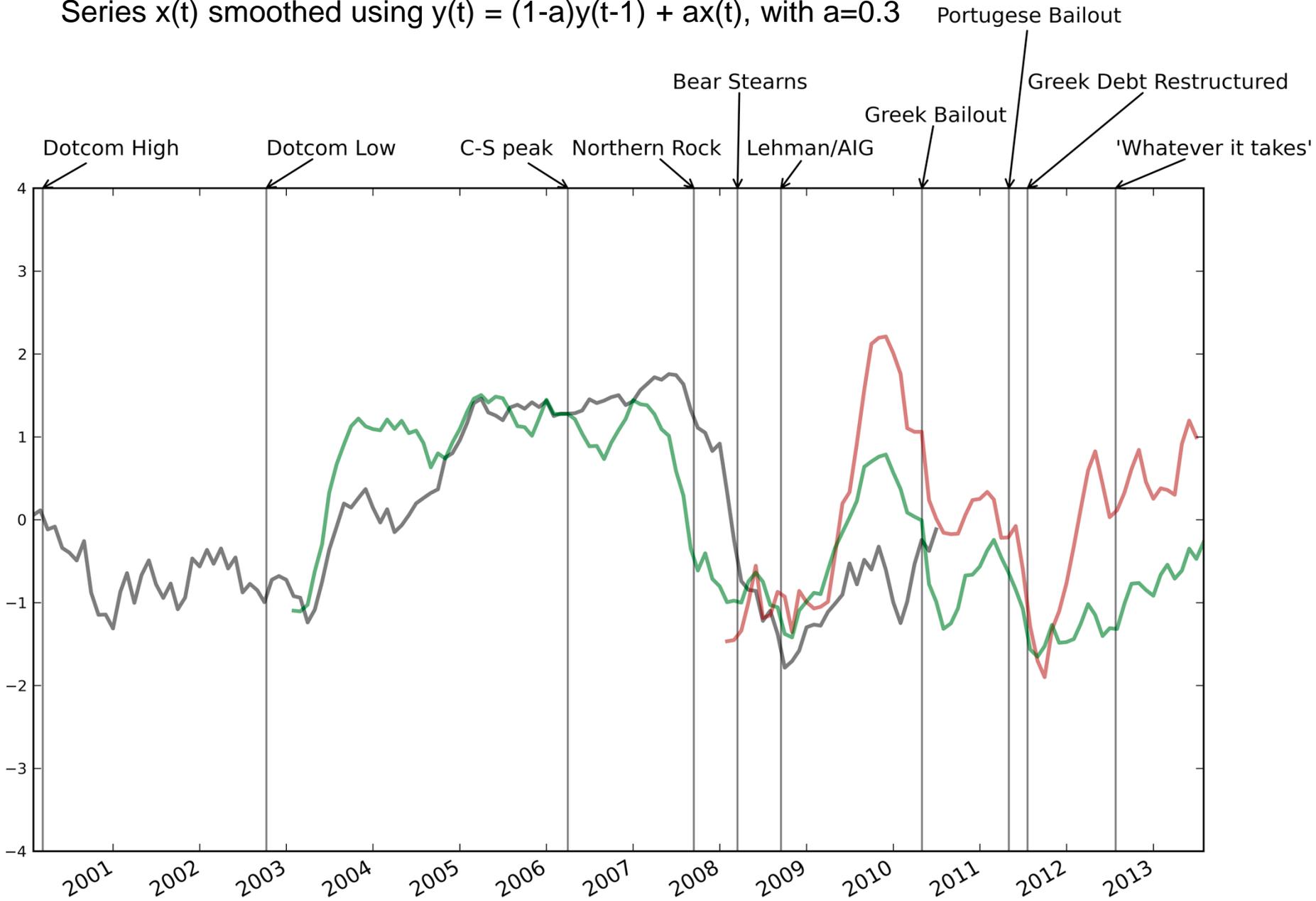
Biggest component of sentiment increase in mid-2000s is anxiety (red)

Series x(t) smoothed using $y(t) = (1-a)y(t-1) + ax(t)$, with $a=0.3$



Largely correlated with **RTRS** (green) and **BROKER** (red)

Series $x(t)$ smoothed using $y(t) = (1-a)y(t-1) + ax(t)$, with $a=0.3$

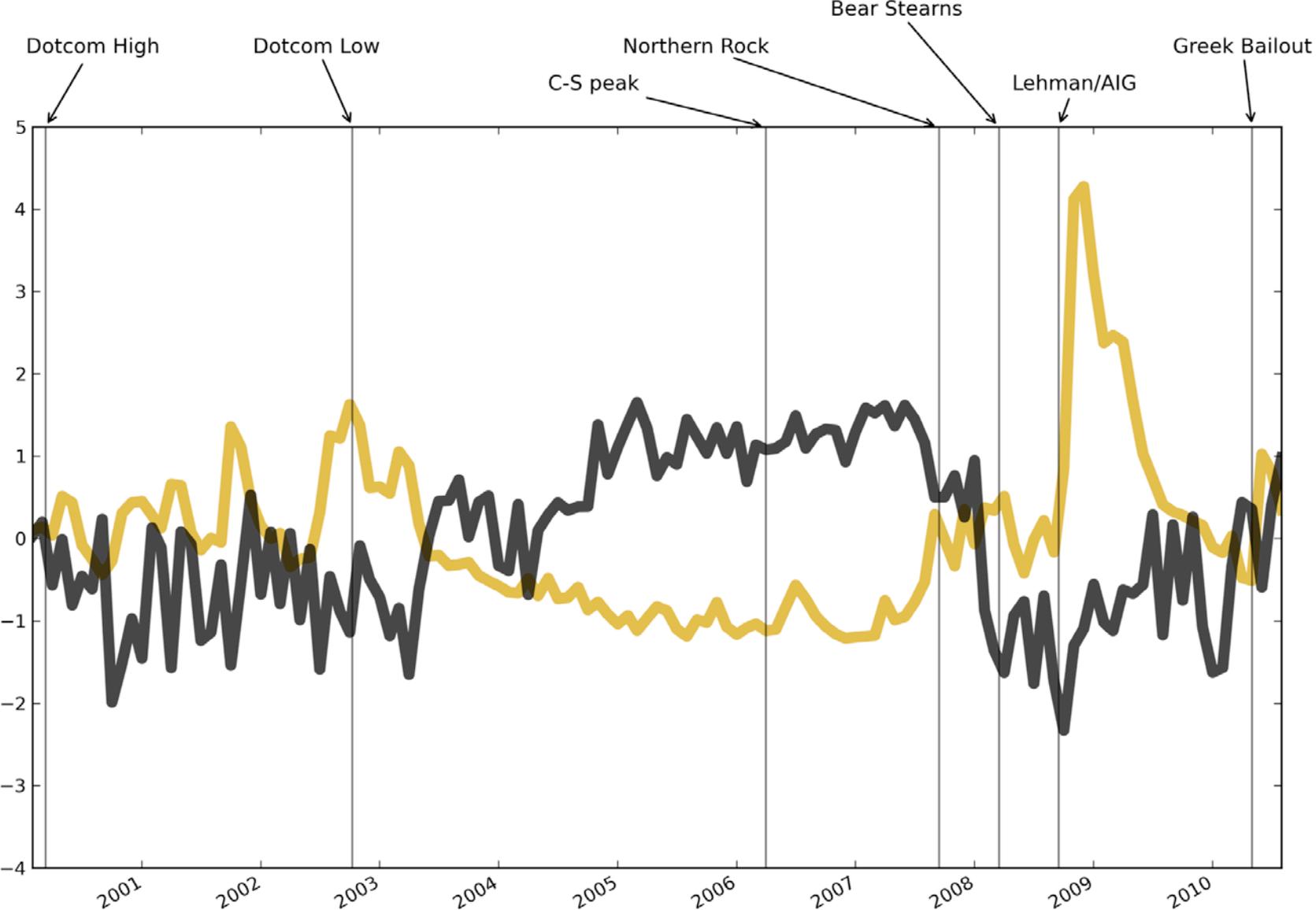


Relative sentiment – How does this compare?

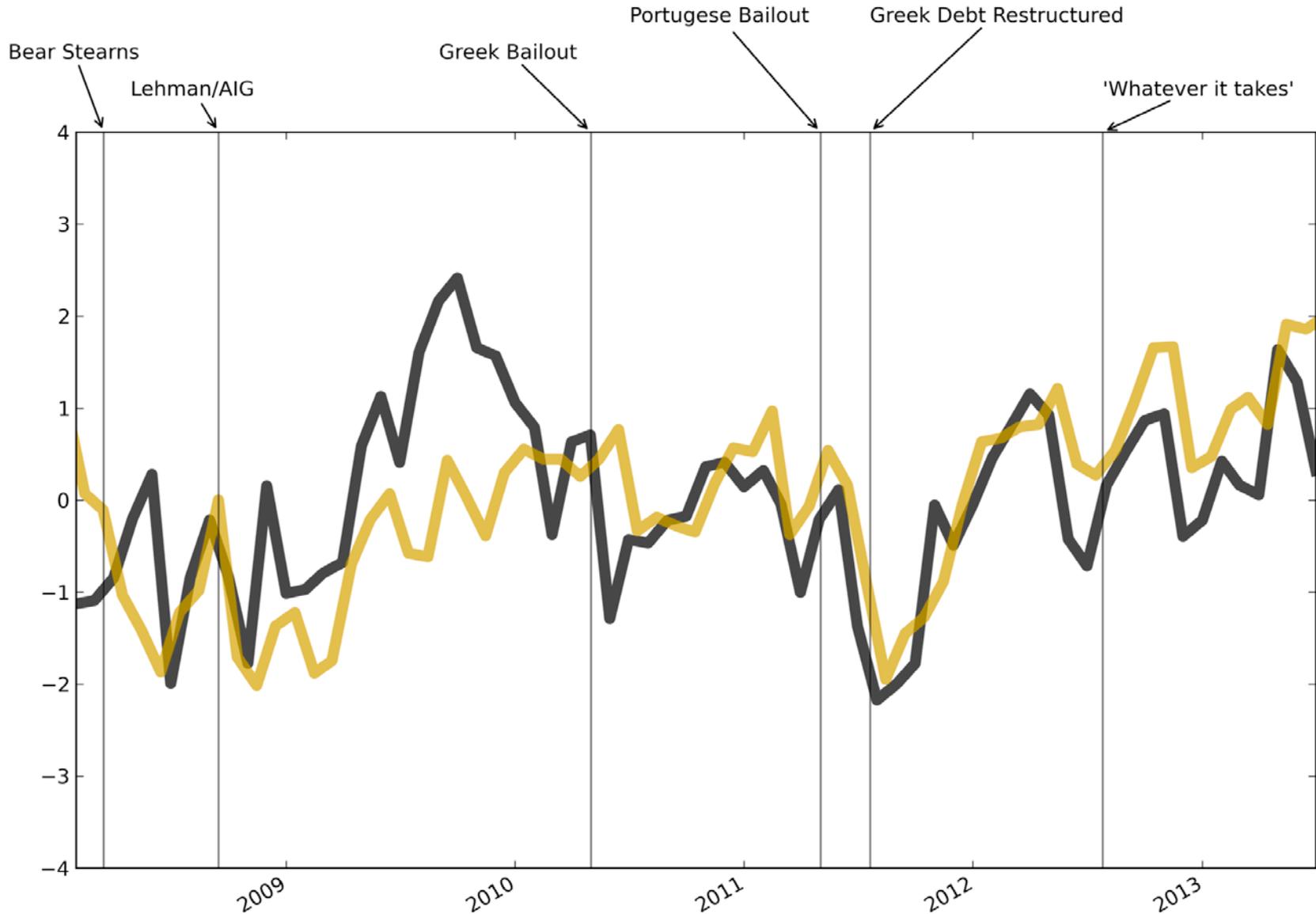
- To better understand what the relative sentiment of these data sources measure we do a few basic comparisons to some existing indicators
 - Simple pairwise correlations
- We look at a small set of ‘macro indicators’ and a small set of ‘market based indicators’
 - E.g., bank balance sheets, interest rates, credit to GDP gap
 - The choice of categories *motivated by expectations from the data*
 - ‘macro indicators’ include the Michigan Consumer Sentiment Index
 - ‘market based indicators’ include the VIX
- MCI and VIX comparisons stand out and illustrate what might be found from different data sources



MCDAILY (black) and VIX (yellow)



BROKER (black) and Michigan Consumer Index (MCI) (yellow)



Relative Sentiment – Detailed comparison

	MCDAILY	RTRS	BROKER	VIX	MCI
MCDAILY	1	0.56	0.29	-0.62(-0.66)	0.27
RTRS	-	1	0.73	-0.44	0.68
BROKER	-	-	1	-0.36	0.58(0.87)
VIX	-	-	-	1	-0.42
MCI	-	-	-	-	1

- MCI three weeks ahead (since June 2010 in brackets)
- VIX within month daily average (one month ahead in brackets)

Granger tests	1 lag, p-value	2 lags, p-value	3 lags, p-value
MCDAILY-> VIX	<i>0.0009025 ***</i>	<i>0.003614 **</i>	<i>0.04153 *</i>
VIX -> MCDAILY	<i>0.09649</i>	<i>0.2874</i>	<i>0.289</i>

Consensus in Reuters News

- From a financial stability perspective it is of interest to analyse the content of *narratives*
 - To identify risk areas (e.g., housing)
 - To measure narrative *consensus* (as a risk to financial stability)
- We will attempt to quantify ‘consensus’ in Reuters, by measuring
 - The number of narratives at a given moment
 - The ‘size’ of each such narrative
- In particular, our measure should satisfy two properties
 - If the number of narratives drops – consensus should increase
 - If some narrative grows to dominate – consensus should increase
- A measure that would achieve these two criteria is the *entropy* of the distribution of topics
 - Entropy is essentially a measure of ‘dispersion’ of a distribution



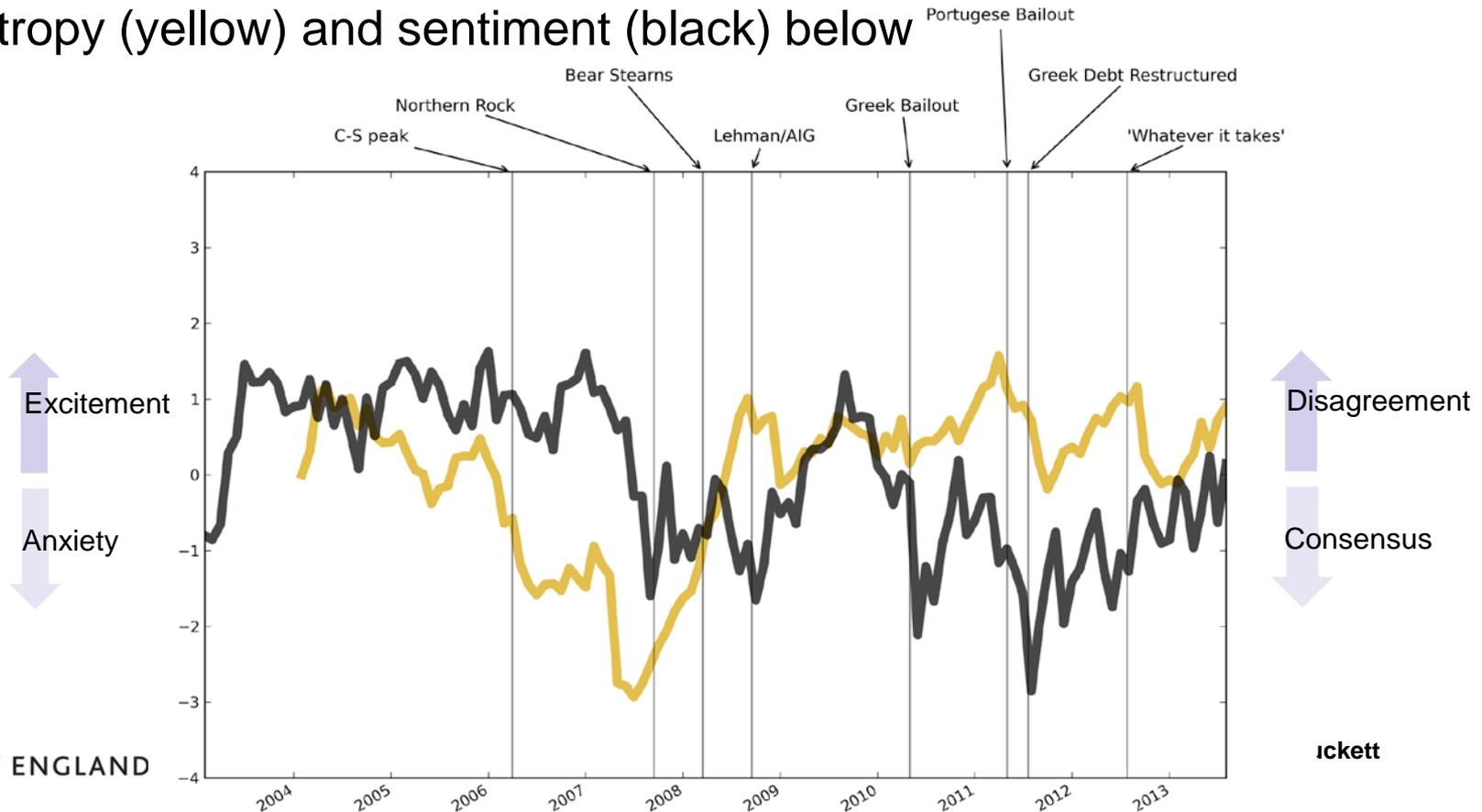
Consensus – Methodology

- A machine learning approach to automatic topic detection
 - We cluster documents after mapping them to vectors
- Vectors created from word/document occurrence statistics
 - Create a *word by document frequency matrix*
 - Remove uninformative words - with extreme (low/high) frequency
- Each column (document) is a vector of word counts
 - But dimensionality is too high and vectors are sparse
 - Very difficult to cluster properly
 - Use principal component analysis (PCA) to reduce the dimension
 - In the new lower dimensional space, the latent factors are more like ‘topics’ - words and documents can correlate over the ‘topic factors’
- Assume that each document belongs to a single topic
- Can now cluster all documents and treat clusters as topics



Consensus – Results

- Arrive at a distribution of documents over the topic clusters
 - E.g., 100 articles about sovereign debt, 300 about oil, ...
- Define *consensus* as the reciprocal of the *entropy*, we plot the entropy (yellow) and sentiment (black) below



Consensus – Results and Interpretation

- We emphasize that this is a measure of *narrative* consensus
 - Not necessarily equal to *market* consensus, presumably reflects what the public wants to read
 - *But* market consensus may also reflect what people read
- We find that consensus clearly increased 2005-2007, a period of ‘low levels of anxiety’ – reflecting the belief in a new paradigm
- May/June 2007 surge in anxiety, consensus increased further
 - Exploring sample documents from the largest cluster tells of
 - Economic uncertainty and bad credit conditions in Europe
- The crisis period that follows clearly stimulates new narratives
 - Perhaps because this provided an opportunity to write new stories!
 - Perhaps due to *increased awareness of uncertainty*



Summary

- We have explored a measure of relative sentiment shifts and narrative consensus in a variety of data sources
 - Internal market commentary, broker reports, and news
- We have found
 - Relative sentiment correlates with significant financial events
 - Sentiment was very high and stable pre-crisis
 - BROKER can potentially be used to forecast MCI
 - MCDAILY can potentially be used to forecast market volatility
 - The consensus metric gives an intuitive representation of the belief in a new financial paradigm pre-crisis
- We have thus found some evidence to support the use of these methods in policy to identify financial system risks and forecast developments in the financial system



Possible Extensions

- Analysis of new data sources, e.g.,
 - Sell side broker reports
 - corporate emails
 - financial news, ...
- Further development of sentiment series
 - Possibly weighting the words
- Further development of consensus
 - Identification and visualisation of the narratives driving consensus
- More econometrics
 - Macro forecasting, we have some evidence linking relative sentiment to GDP (*'nowcasting'* and *forecasting*)
 - Financial forecasting, VIX?
- Comparison to other indicators?

