UCL

NEWS AND NARRATIVES IN FINANCIAL SYSTEMS:
Exploiting big data for systemic risk assessment

Rickard Nyman, David Gregory, Sujit Kapadia, Paul Ormerod, David Tuckett & Robert Smith
(University College London, Centre for the Study of Decision-Making Uncertainty and Bank of England*)

September 24th 2015
2015 RiskLab/BoF/ESRB Conference on Systemic Risk Analytics
Bank of Finland

Objectives

❑ Introduce a new interdisciplinary theory of human decision making, conviction narrative theory (CNT).

❑ Set out a new method of Big Data analysis (Directed Algorithmic Text Analysis - DATA) and a related method, CONSENSUS, for assessing Narrative Topic Dispersion.

❑ Present some results to show how these methods can be used to capture and gauge systemic risk in the financial system.

❑ Consider some wider results and the methods' validity.

❑ Consider how and why these methods work and how they might develop in further collaborations.

# Two System Decision -Making Model
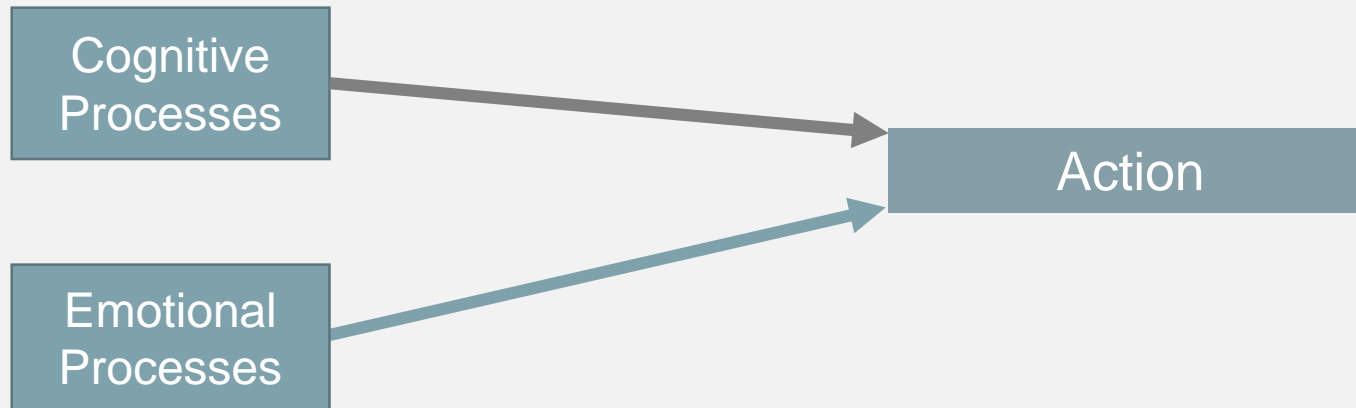
CNT Decision -Making Model
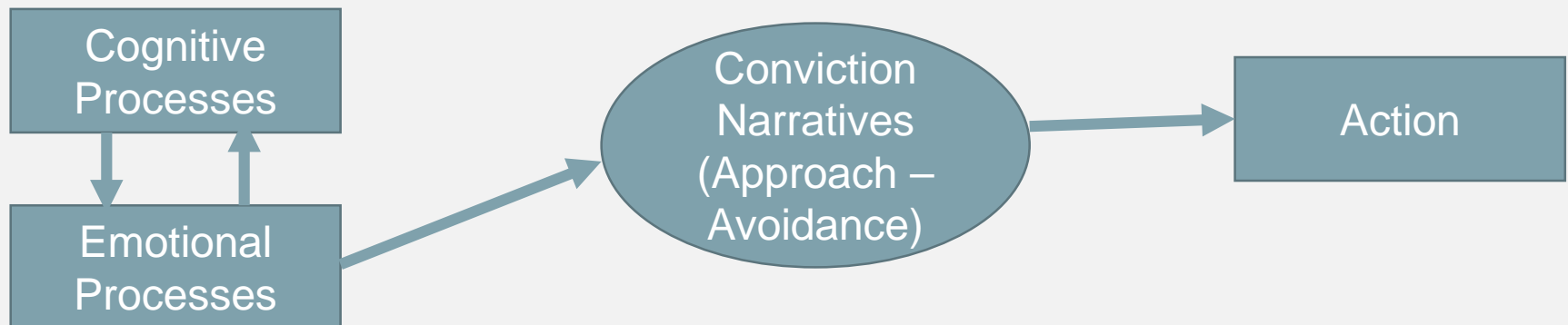
Conviction Narrative Theory (CNT)

❑ Human actions have produced a complex and constantly evolving world in which many decisions (such as financial decisions) are made in a context of radical uncertainty – that is where objective probabilities for outcomes are not available, *ex ante*.

❑ Decisions to act in these circumstance draw on human abilities to calculate and create scenarios of the future (narratives) that are very different to those in a computer programme. Such narrative construction has three functions:

1. To interpret the situations we are in, which means fitting them to a prior-conceived pattern of observations and so reducing the prediction problem required to make sense.

2. To form alternative pictures of the future outcomes of possible actions and to imagine their impact.

3. To create a sense of accuracy and conviction about a preferred alternative, i.e. a narrative that creates a sufficient **subjective** feeling of certainty and accuracy to generate expectations and to act (often with others).

❑ In CNT financial assets are priced in a fragile equilibrium – the outcome of shifting consensus narratives about underlying "fundamentals", potentially creating systemic risk via groupthink and divided states.

❑ The potential for inertia caused by uncertainty and possible loss is overcome by creating preferred narratives of the future in which agents have subjective trust – conviction narratives.

❑ They draw on human capacities that have adaptively evolved in human bodies – for example, embodied cognition and the ability for "mental time-travel" which allows them to compose embodied narratives of future outcomes, including those that have never happened before, etc.

❑ Through embodiment, different cognitive elements in the stories that agents simulate as they read, imagine or listen, each evoke **approach** or **avoidance** emotions with the effect that the outcomes of preferred actions both feel and are thought accurate and desirable.

❑ Approach-Avoidance emotion shifts therefore suggest increases or decreases in (potentially) risky behaviour.

❑ Note - Narratives are experienced as convincing through an emotional appraisal process which involves the body and readies action, involving processes which have been described in the experimental and social science literature.
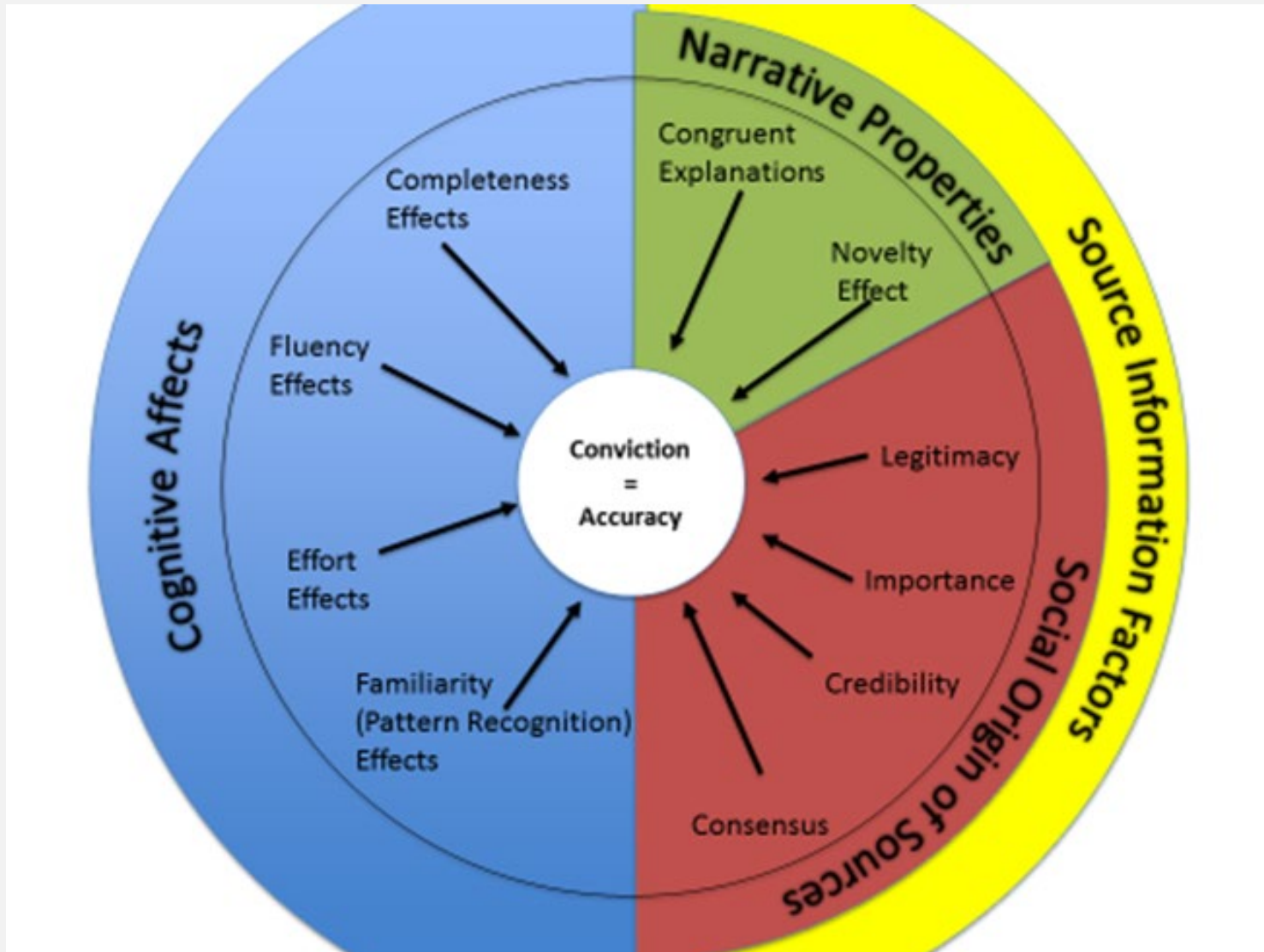
Methods

❑ DATA is a method for assessing Relative Sentiment Shifts (RSS) – i.e. shifts in the relationship between approach and avoidance emotions - in economic narratives.
  ✓ Applies to any unstructured text database with dated texts.
  ✓ Wil be used today on three document sets the Reuters News (2.2m US, 1.8m UK), broker reports (available series taken from BoE files comprised 14 brokers' commentaries from January 2008 through June 2013 consisting of about 100 documents per month of a primarily global economic focus) and daily internal Market commentary from BoE staff produced at the rate of about 26 per month from January 2000 to January 2010.
  ❑ Current prototype RSS uses a simple dictionary (word list) with no weighting.
    ✓ Attends to words indicating approach or avoidance only. Stable set.
    ✓ Creates time series.
    ✓ Allows econometric and other powerful statistical analysis.

❑ CONSENSUS is a method for assessing changes in topic dispersion in digital narratives which we use to ascertain whether market narratives may be becoming more or less narrow.
    ✓ Uses a straightforward approach of clustering the articles in word-frequency space (after removal of commonplace words) to form topic groups, whereby each article belongs to a single distinct topic. We then measure the uncertainty (entropy) in the distribution of the articles across the topic groups. We consider an increase in the uncertainty (entropy) of the topic distribution as a decrease in consensus and vice versa.

Methodology

☐ Parsimonious word frequency methodology

- ✓ Intentional simplicity
  - Can potentially refine using more sophisticated methods
- ✓ Ease of interpretation
- ✓ (#Excitement - #Anxiety)/#Words
- ✓ Fixed methodology across applications

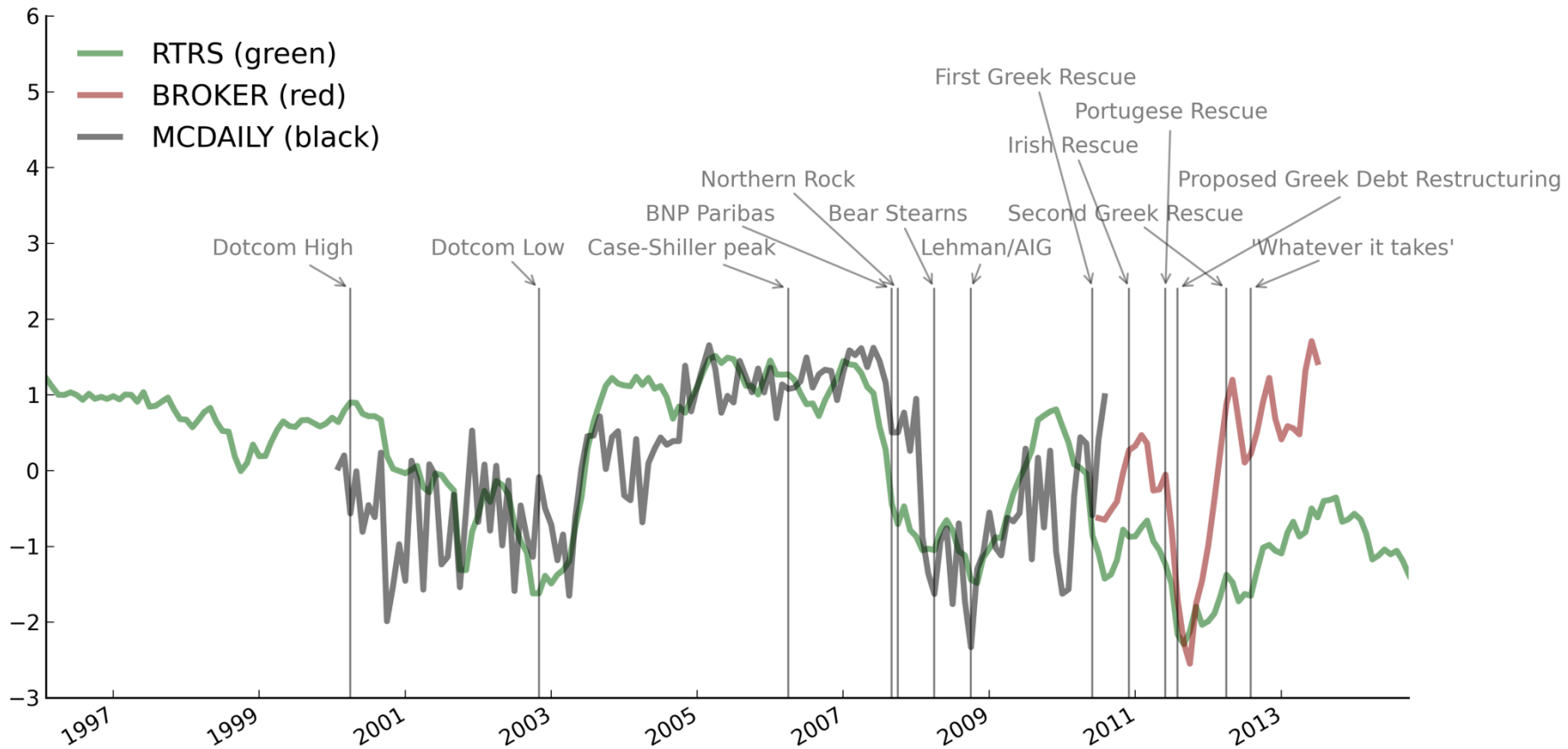Emotion dictionary samples

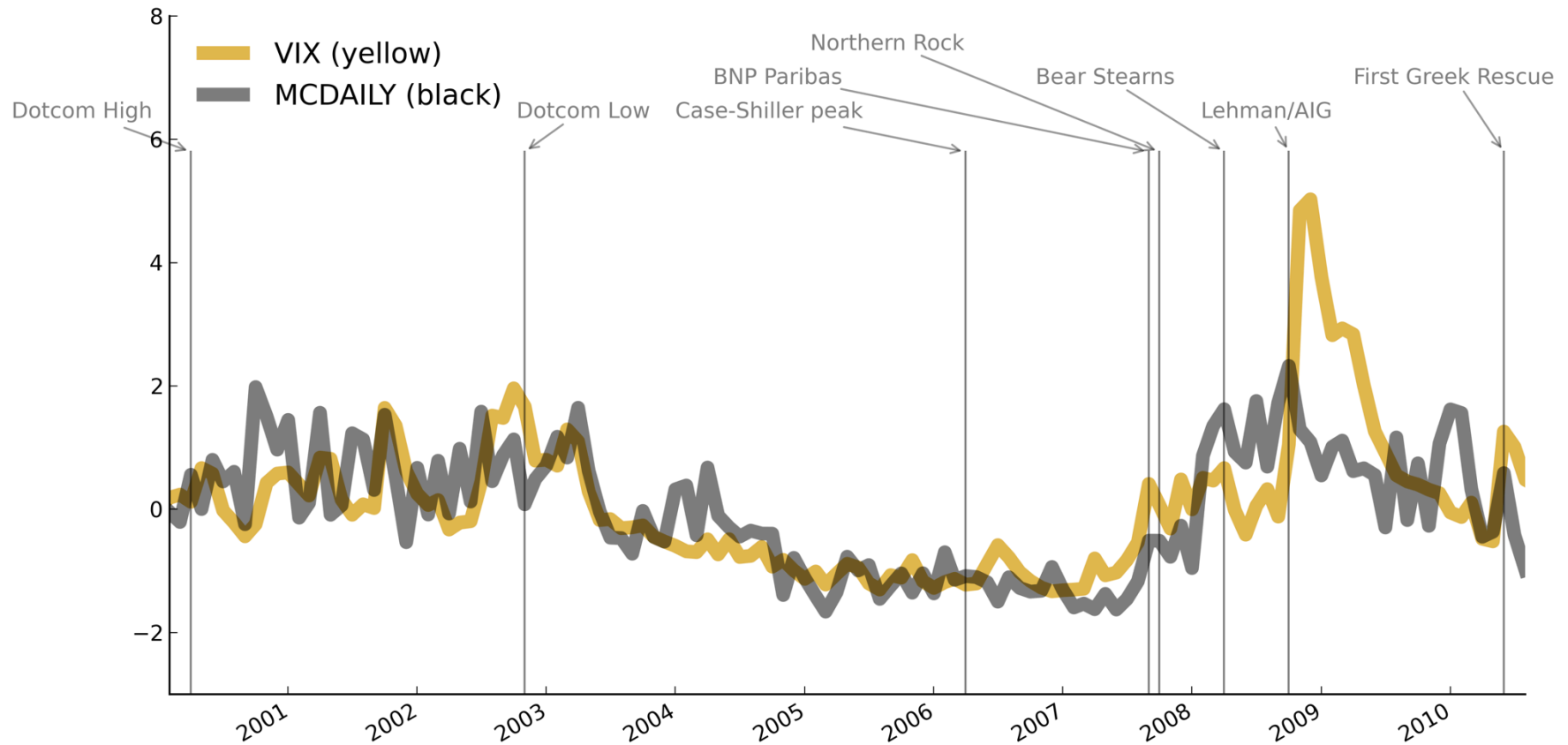| Anxiety	Anxiety	Excitement	Excitement
Jitter	Terrors	Excited	Excels
Threatening	Worries	Incredible	Impressively
Distrusted	Panics	Ideal	Encouraging
Jeopardized	Eroding	Attract	Impress

RSS Bank Market Reports
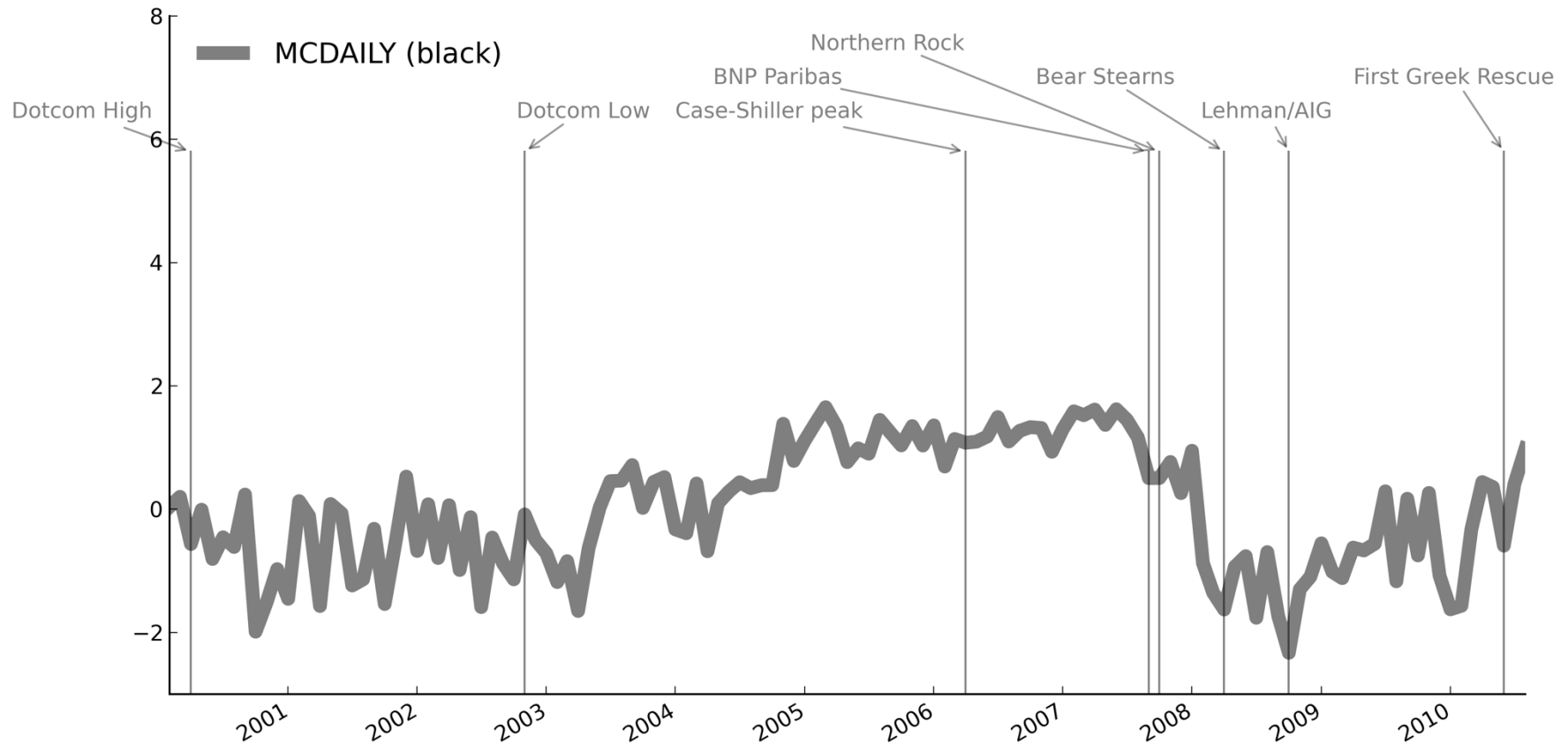
RSS: Reuters, broker reports, market reports

RSS Market reports & VIX

Granger Causality

❑ P-values causality from RSS to economic variables
❑ P-values causality from economic variables to RSS

Wald test p-values of Granger-causality from the relative sentiment shift series

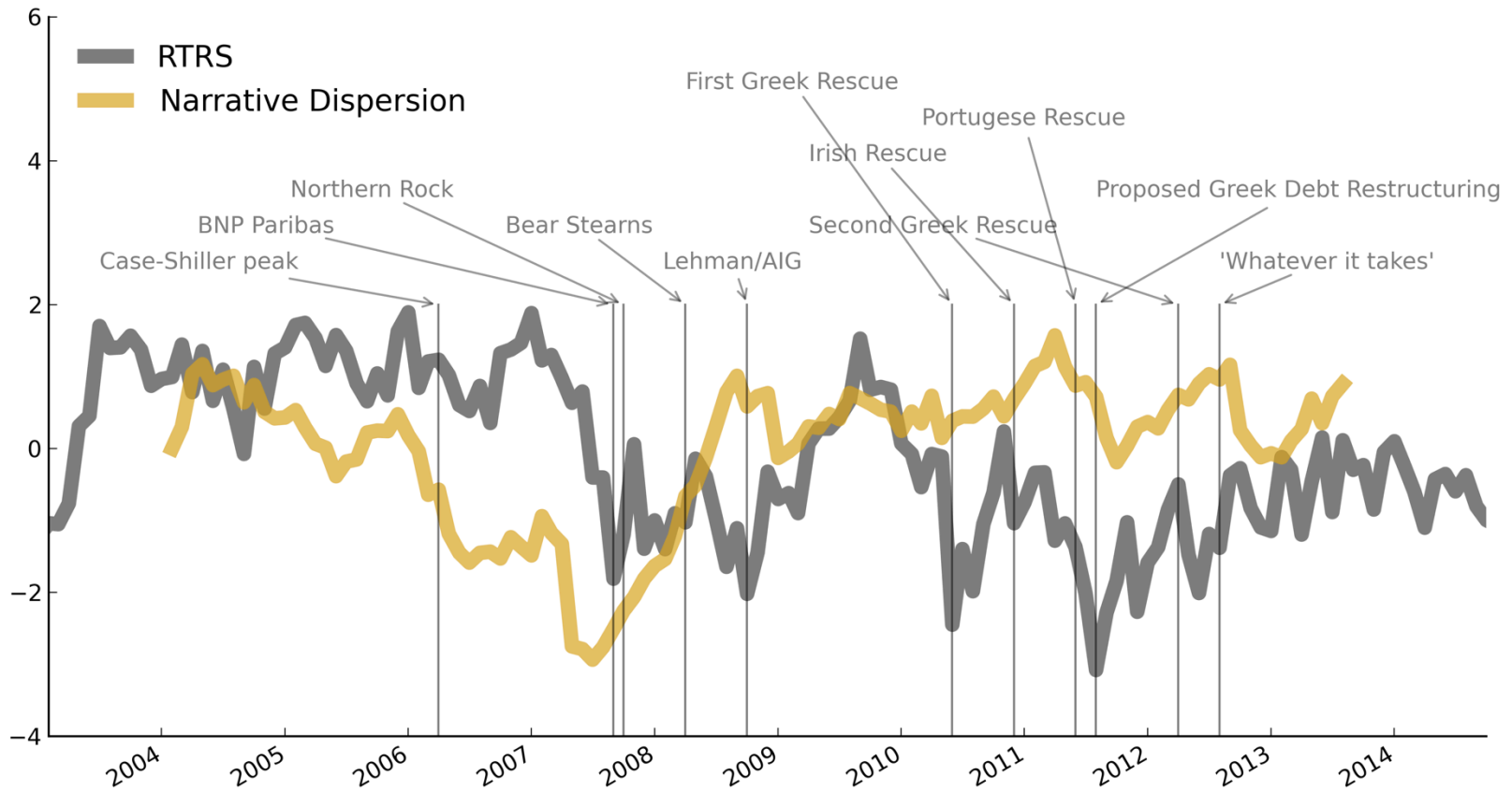RTRS, BROKER and MCDAILY, and their component parts, to MCI, VIX and BoEU

and vice versa

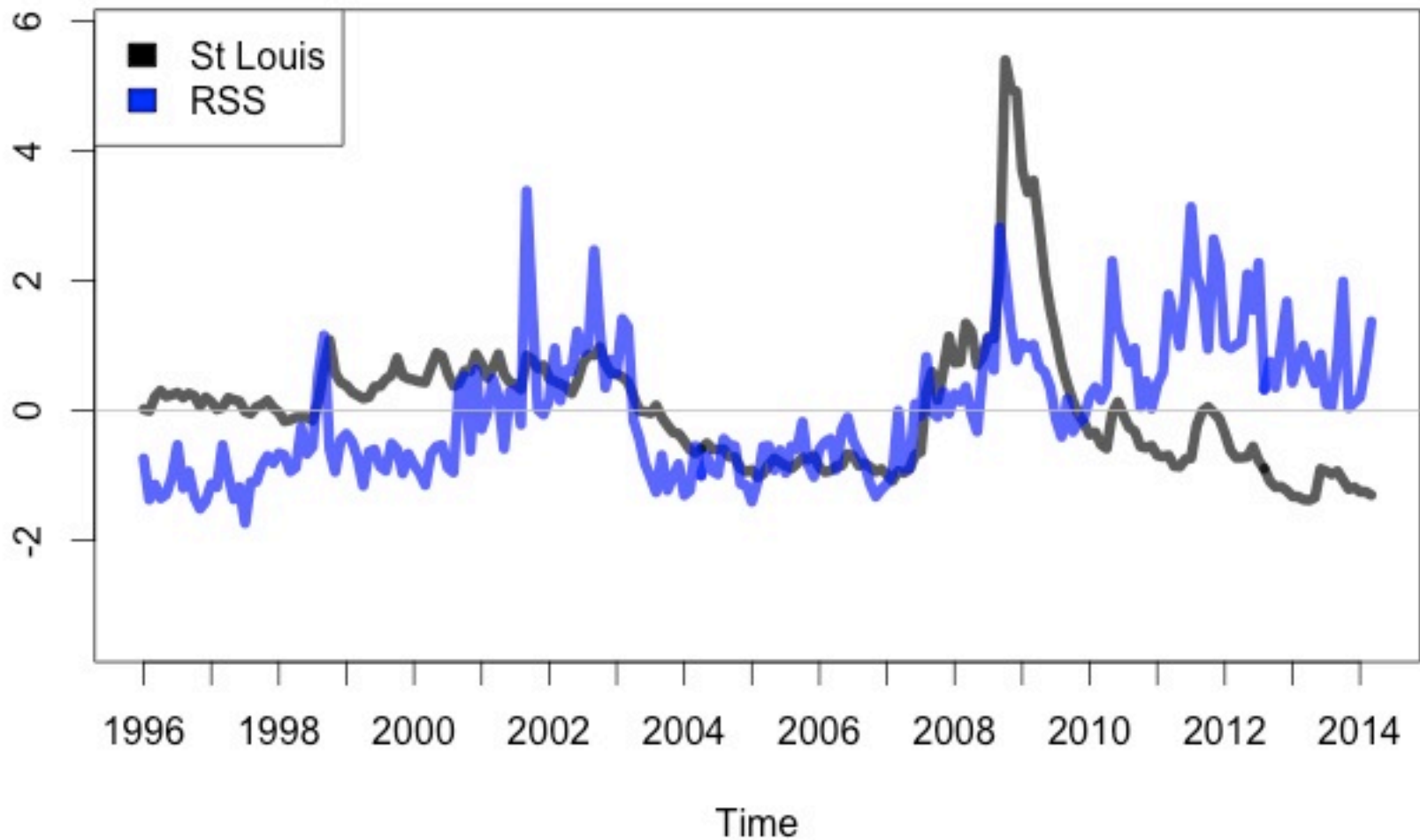| RSS Series	MCI	VIX	BoEU
RTRS EXC-ANX	0.005**	0.28	4e-06**
RTRS EXC-ANX	0.29	0.093	0.022*
MCDAILY EXC-ANX	0.5	0.09	6e-05**
MCDAILY EXC-ANX	0.95	0.39	0.58
BROKER EXC-ANX	2e-11**	0.18	
BROKER EXC-ANX	0.94	0.16	

Note: *p<0.05; **p<0.01

Topic Dispersion

Predicting the St Louis Financial Stress Index
(0= Normal)

Wald test of Granger causality between Financial Stress Index and the Relative Sentiment Shift Index

Direction	Chi-Sq	d.f.	p-value
STLFSI -> RSS	3.4	4	> 0.5
RSS -> STLFSI	24.5	4	0.00006***

Note: *p<0.1; **p<0.05; ***p<0.01

RSS leads the St Louis index

Divided State Theory

❑ In CNT, all decisions made under uncertainty necessarily require conviction narratives.

❑ Conviction is achieved by imagining possible narrative outcomes which evoke approach and avoidance.

❑ Under uncertainty most narratives will contain some grounds for feeling approach and some for avoidance.

❑ "Divided state" - a situation in which certain topics or situations exhibit an unusual lack of balance – either avoidance or excitement seem to diminish or disappear.

❑ **Hypothesis: An unusually sustained and significant relative gap in the dominance of approach over avoidance words around particular topics can be used to indicate that thinking and decision-making around these topics has become unbalanced therefore, is at risk for a reversal.**

Liquidity
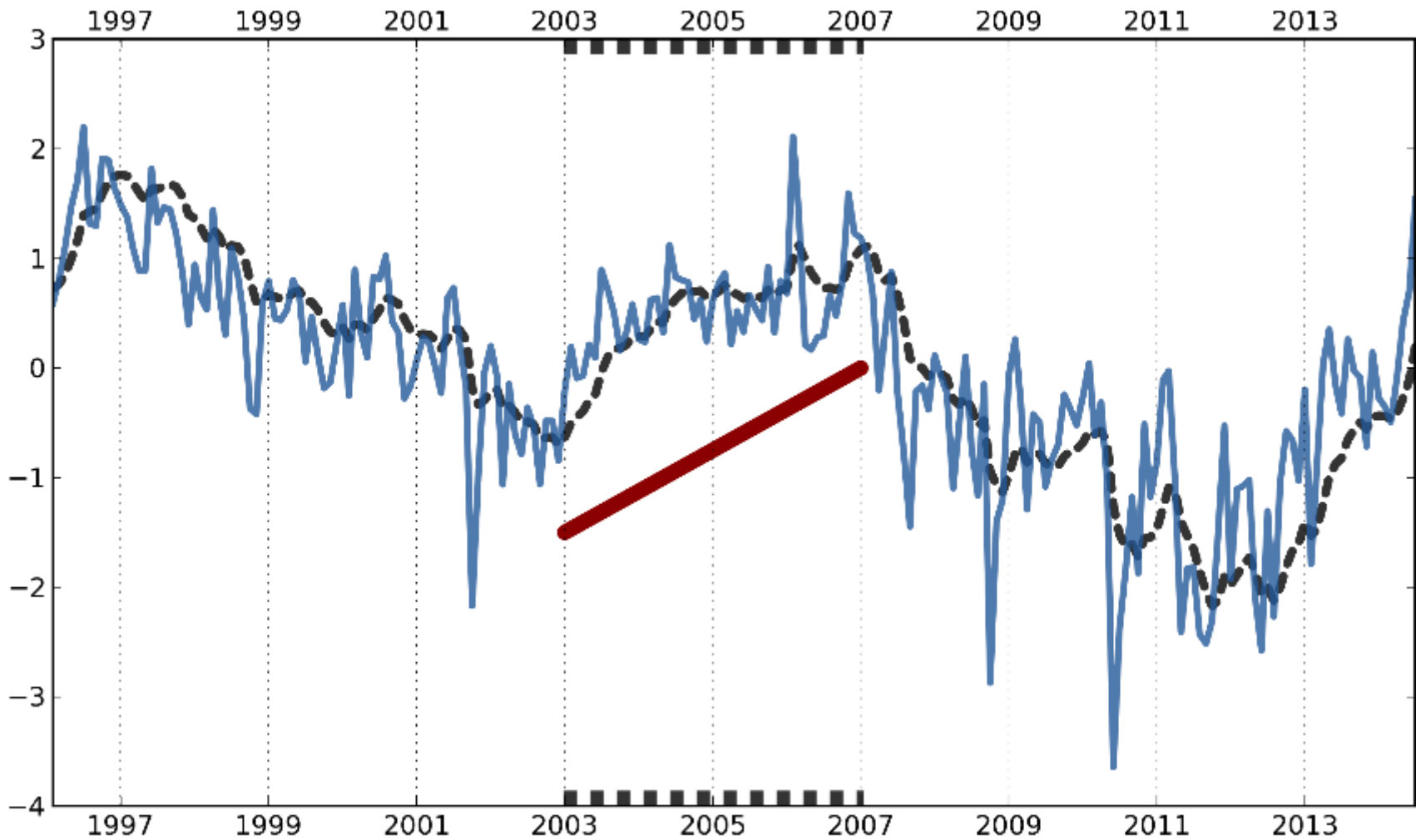
Fannie Mae
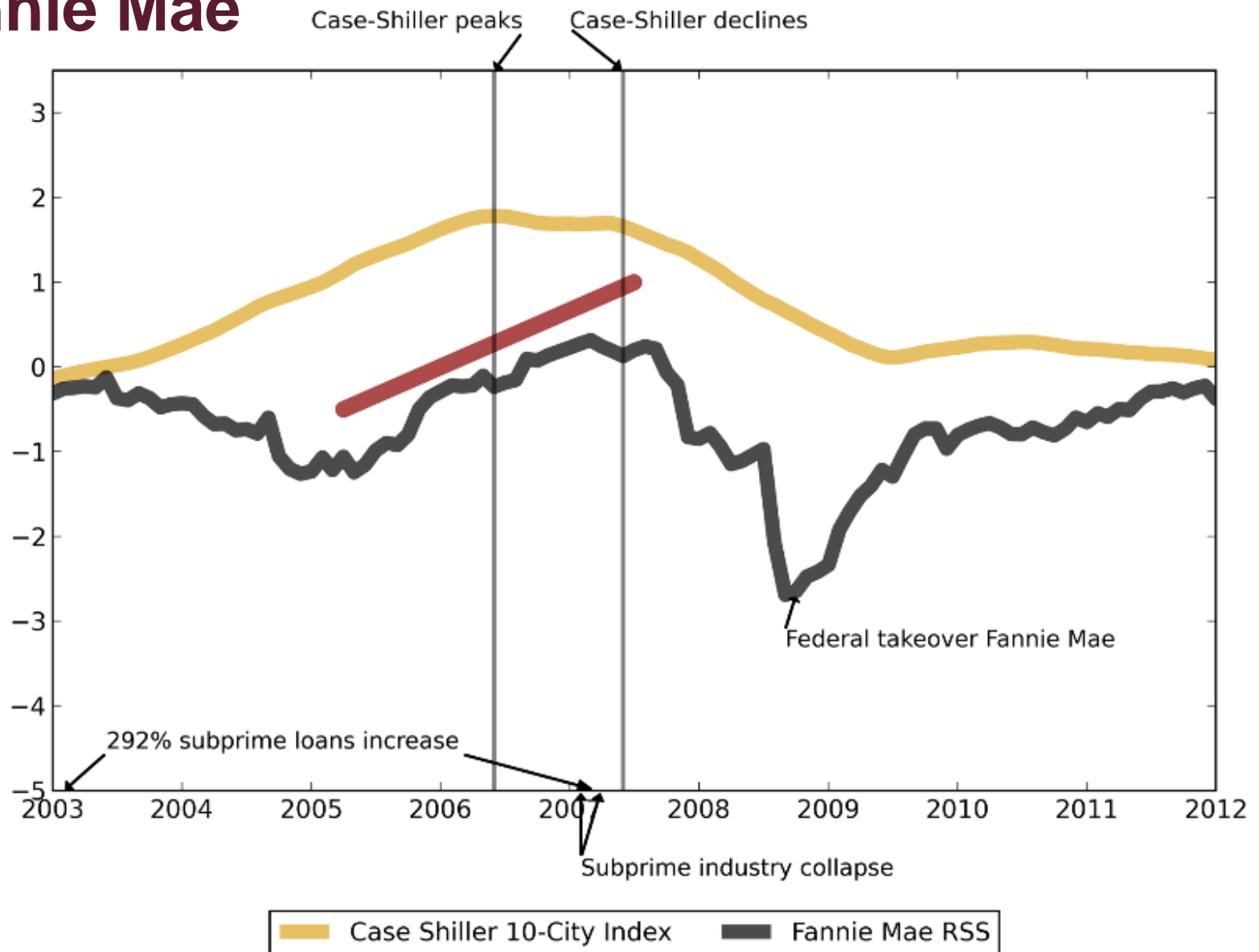
Discussion

❏ RSS
- ❏ Theoretically defined measure linked to the way decisions are made. Intuitive. Picks up aggregation.
- ❏ Very Fast, No revisions.

❏ Enhanced or Additional Data Sources:
- ❏ Blogs, social media, chat, company documents, regulator interviews?

❏ Enhanced Emotion Recognition Techniques
- ❏ Enhanced word lists, NLP, etc.

❏ Enhanced Topic Identification Techniques

❏ Risk Assessment
- ❏ Potential to compare institutions.
- ❏ Stranded asset or carbon risk.

❏ Collaborations?

Acknowledgements and Thanks

References to CNT and DATA

❑ Nyman, R., et al (2015 in press) News and narratives in financial systems: Exploiting big data for systemic risk assessment Bank of England Working papers series, 2015.

❑ Tuckett, D., et al. (2015) Uncertainty, Decision Science, and Policy Making: A Manifesto for a Research Agenda. Critical Review. http://dx.doi.org/10.1080/08913811.2015.1037078

❑ Tuckett, D., Smith, R. E., & Nyman, R. (2014). Tracking phantastic objects: A computer algorithmic investigation of narrative evolution in unstructured data sourcesSocial Networks, 38, 121–133. http://www.sciencedirect.com/science/article/pii/S037887331400015X

❑ Tuckett, D (2014) Uncertainty, Conflict and Divided States: Some Psychological Foundations for Macroprudential Policy.http://www.bankofengland.co.uk/research/Documents/pdf/tuckett_0414.pdf.

❑ Tuckett, D., Ormerod, P., Nyman, R., and Smith R.E. (2015) http://206.191.128.204/ideas-papers/research-papers/information-and-economics-a-new-way-to-think-about-expectations-and-to-improve-economic-prediction (under review)

❑ Tuckett, D.A and Nikolic, M., (2015) The Role of Conviction in Decision-Making Under Deep Uncertainty. https://www.researchgate.net/publication/276376031_The_Role_of_Conviction_in_Decision-Making_Under_Deep_Uncertainty (under review)

Source References for CNT

❖ Baumeister, R.F., & Masicampo, E.J. (2010). Conscious thought is for facilitating social and cultural interactions: How mental simulations serve the animal-culture interface. Psychological Review, 117, 945-971.

❖ Bruner, J., (1986) Actual Minds, Possible Worlds. Boston: Harvard University Press,

❖ Bruner, J., (1990) Acts of Meaning. Boston: Harvard University Press.

❖ Barsalou, L. W. (2008). Grounded cognition. Annu. Rev. Psychol., 59, 617-645.

❖ Frijda, N. H. (1986). The emotions. Cambridge University Press.

❖ Frijda, N. H. (2007). The laws of emotion. Lawrence Erlbaum Associates Publishers.

❖ Friston K, Stephan KE. (2007) Free energy and the brain Synthese. 2007. 159:417–458

❖ Gallese, V and Goldman, A. (1998) Mirror neurons and the simulation theory of mind-reading. Trends Cogn Sci. 1998 Dec 1;2(12):493-501.

❖ Granovetter, M. (1985) 'Economic Action and Social Structure: The Problem of Embeddedness', American Journal of Sociology, 91, 481–510.

❖ Lazarus, R. S. (1991). Progress on a cognitive-motivational-relational theory of emotion. American psychologist, 46(8), 819.

❖ Suddendorf, T. & Corballis, M. C. 2007 The evolution of foresight: what is mental time travel and is it unique to humans? Behav. Brain Sci. 30, 299–313.

❖ Swedberg, R. (1993) 'On the Relationship Between Economic Theory and Economic Sociology in the Work of Joseph Schumpeter'. In Swedberg, R. (ed.) Explorations in Economic Sociology, New York, Russell Sage Foundation, pp. 42–65.