

The Future of Macroeconomics: Why Observation of the Behaviour of Human Actors and How They Combine Within the Economy, is an Important Next Step¹.

David Tuckett

1. Introduction

One might think of the satisfied consensus reigning in macroeconomics before the financial crisis (and still relatively entrenched) as evidence of “Groupthink” in a “Divided State” (Tuckett, 2011, Tuckett and Nikolic, 2017). I mean by this language that a consensus seems to have developed in a collective mental state characterised by excitement at impressive in-group theories with at the same time an emotional refusal to spoil the achievement by true enquiry into possibly contradictory knowledge of agent reality developing in other fields. In an “integrated state” a truly confident group of theorists would feel secure because they would be able to go out of their way to ensure a reasonable match between evidence of the behaviour of real-world economic agents and the way they interact with models of the behaviour of the aggregate economy in which they participate.

From this viewpoint, a possible future for macroeconomics is to ground itself on field-generated models based on scientifically supported observation of how human agents in real-world contexts make economic decisions and how they respond to each other to combine to produce aggregate outcomes. The task requires us to understand how decisions made by sentient and social human actors, operating in what is often a context of radical uncertainty, combine together.

Keynes, perhaps the intellectual father of macroeconomics, tried to set out how aggregate economic outcomes can eventuate in dynamic states of disequilibrium. As I think he saw it, disequilibrium is an occasionally to be expected outcome of the way human actors endowed with animal spirits cope with the radical uncertainty that is constitutive of financial

¹This paper, and particularly the empirical work described in section 4, would not have been possible without the work of others at the UCL Centre for the Study of Decision-Making Uncertainty and particularly Dr Richard Nyman. In addition to support from three grants from the Institute of New Economic Thinking, I also wish to acknowledge support from the Eric Simenhauer Foundation of the Institute of Psychoanalysis (London), a private donor and the UK Research Councils (EPSRC and ESRC). I also wish to thank Sujit Kapadia and Andy Haldane at the Bank of England and Chrystia Freeland, Richard Brown, Maciej Pomalecki, Eric Fishkin, Joel Sebold, Dennis Goett and Vesna Gvozdenovic of Thomson Reuters for arranging access to the Reuters News archive.

and economic action. In their enthusiasm for what they thought as rigour but what might better be thought of as an ideological pursuit of a fictional equilibrium, New Keynesian models produced by those who claimed to be his successors, obliterated with some contempt², as sons have been known to wish to do, the central advances towards understanding the dynamics of a modern economy that Keynes himself made.

If it can escape its current consensus, one way in which future macroeconomics may develop productively to re-establish a credible reputation is by incorporating secure advances made in other areas of economic thinking – for instance, information economics or game theory – or by using new methods of analysis and data handling from physics and computer science, such as agent based modelling and machine learning.

The message I wish to convey, however, is that even these significant advances will be inadequate to the task unless a more fundamental issue at the heart of economic thinking is faced – it derives from the fact that human economic agents simply *cannot know* the economic facts of the world or co-ordinate on them except through their human interpretive and perceptive capacities, necessarily based on brain architecture and psychology located in specific social environments. I will be arguing that one way they do this is through shared narratives about the facts – the facts themselves being unavailable except via perception.

To put the underlying problem in another way, humans can interpret facts and experience as they wish and collectively go on doing so for a long while. They are free to be fallible – as George Soros (1987) pointed out in setting out his reflexivity theory.

In the language of contemporary brain as well as social science, we make or construct the world to which we respond and on which we act, through embodied social action. Freedom to be fallible is the freedom not to accept the current view and to innovate (Esposito, 2016). It is why the social and economic world is dynamic and innovative. Self-reflection could demonstrate this. Macroeconomists have been free to develop and propagate narratives about the economy and how it works for some fifty years. These beliefs have won Nobel prizes and underpinned central bank action despite their shaky foundation in fact. Every other human group acts on its beliefs in the same way. People voted for Brexit or Trump to gain a supposed advantage. Evidence may emerge that they were right but the very

² Lucas, according to Mankiw (1999) and Krugman (2009), report that in the 1970's people in seminars would giggle at Keynes' theorising.

opposite is also likely. Importantly, what will prove true will not be known for a long time and perhaps never.

My point is that human social actors do what they think is sensible and little is gained by calling such behaviour irrational, which is why sociologists and social anthropologists since Weber have usually stuck to analysing social and economic action in terms of rational action, that is action seen from the viewpoint of the actor. Beliefs are constitutive of social reality and so social scientists examine the impact of these beliefs and make no judgements whatsoever as to whether, by some externally created normative standard actors, they are correct or not. In fact, according to Parsons (1937 especially p132-142 and p204-5) both Pareto and Marshall had already recognised the limitations of normative thinking as a solution to the problem of order (i.e. equilibrium) and were edging away from it.

In this contribution, I want to suggest that contributions from social and psychological science, based on the principles of rational action just enumerated, might enable a paradigm shift in macroeconomic research and make a significant contribution to future macroeconomics. Specifically, I will outline some features of a social-psychological theory – conviction narrative theory (CNT) – that has been developed in my UCL Centre and which seems capable of providing a more realistic foundation for understanding dynamic aggregate economic outcomes. I will then present some quite promising empirical results derived from a new method influenced by CNT which identifies (1) when over-exuberant risk-taking may be present in financial markets and (2) the possible influence of animal spirits in driving significant directional changes in the evolution of the economy.

2. The Conditions for Action Matter

In 2007 and again in 2011, I undertook an interview study of significant asset managers in the global economy (Tuckett, 2011, 2012). A few years before, Thomas Bewley, a distinguished mathematical economist, interviewed over 300 business leaders during a recession in the early 1990's in the North Eastern United States (Bewley, 1999). Significantly before that, George Soros (1987) published a detailed diary of his day to day decision-making in financial markets along and presented his reflexivity theory in which financial agents interact and influence each other. There have been many investigations and case studies of organisational functioning and a great deal of fieldwork conducted in a wide variety of economic settings by sociologists and social anthropologists (see Guillen et al, 2003; Beckert and Aspers, 2011; Knorr Cetina and Preda, 2005).

It is hard to know if such work accurately infers or not how people usually and actually made decisions. It's not important for such studies because what they do, beyond doubt and like other work in the social sciences, is to describe what Bewley called "the conditions constraining decision-makers" (p 7) - the contexts, in other words, with which individual economic actors have to contend whether trying to make "fully rational" decisions or not.

None of the descriptions of decision-making in the three studies just mentioned are consistent with standard models. Other studies, for example, those examining large spending decisions in corporations and government departments describe processes equally inconsistent. Decisions are a result of complex innovative or organisational processes (for instance, Simon, 1997, Vuori and Huy, 2016; Sull and Eisenhardt, 2015; Lane and Maxfield, 2005), in which economic agents deal with uncertainty in a way that is almost entirely inconsistent with what is assumed to be the case for the "representative agents" of standard macroeconomics.

Radical uncertainty, in fact, is what most of today's major companies and government agencies actually face. To take some topics recently presented to the UK Engineering and Physical Science [CRUISSE network](#), which is charged with developing academic insights to help their decision-making, these economic agents are facing hard or "wicked" problems which force them to guess the impact on them of future developments that even the experts they consult or employ are often very unsure about. How much money should be spent on cyber security? How to mitigate or benefit from the effects of changing weather and climate change? For government departments, which new technologies is it safe to allow to be owned by foreign companies? What regulations should be applied to restrict future technology? What threats will exist and what armed services with what equipment are required ten and twenty years out? How do we design resilient infrastructure for the long term and how much to spend on it? And then there is Brexit. To paraphrase a coming expert lecture at UCL, the UK's relationship with the EU may go through profound changes after Brexit. What changes for EU funding in the U.K. will be involved? What happens after that? What are the key decisions that need to be made? Indeed, who is even going to make these decisions and with what outcomes?

Outside abstract academic modelling, no study of the activity of real world economic agents faced with the typical problems they actually face is suggesting, in the context they find themselves, that they have any hope of calculating the expected probability of outcomes

and so an optimal path over an infinite horizon. They are not even sure they can anticipate all options. As Berezin (2005) observed, rational choice, in the restricted economics sense, can apply only in those limited instances where the choice context is stable or predetermined. Theories based on rational expectations, which require rational choices to co-ordinate according to the Von-Neumann Morgenstern axioms, necessarily recede before a great deal of empirical reality, which is uncertain.

Moreover, the problem posed by uncertainty for optimality is not solved by making the apparently more limited assumption of “bounded rationality”. Simon (1946), who proposed the concept, was very clear about this. Those who have used his concept have very often missed the point. Simon wrote in the Quarterly Journal of Economics that “broadly stated, the task is to replace the global rationality of economic man with a kind of rational behavior that is compatible with the access to information and the computational capacities that are actually possessed by organisms, including man, *in the kinds of environments in which such organisms exist.*” (italics added). The italics are there to remind that he was referring not only to the computational or behavioural limitations of human actors. Rather, what he had in mind was his “scissors” analogy. On one blade is the structure of the context in which many decisions have to be made, the conditions for action which are often radically uncertain, and on the other, is human capability, augmented nowadays by human invented machine support.

My principal point is that the problem with the concept of rational expectations is its ecological validity in the large world context to which it is applied. Humans are goal-oriented but not limited and so irrational in the means they chose to achieve them due to their limited capacity to remove bias from their calculations. There are no sound grounds for believing that in a human populated financial market “correct” expectations will converge. The problem is the context decision-makers face, in which, in fact, they are not restricted to some optimising procedure and are far better adapted than a machine (Gigerenzer, 2008). It is for this reason (see also King, 2016) that behavioural economics or finance based on the heuristics and biases movement – i.e. the study of human error in conditions of risk – is unlikely to make a significant contribution to macroeconomics. Rather, the future of macroeconomics requires a major *mental shift* away from models developed in the current groupthink mode and towards models based on incorporating the implications for their decision-making of the conditions of action that face economic agents. The shift might be, perhaps, “nudged” by institutional design, that is *an organised shift in incentives* implemented by research councils and

macroeconomic consumers like central banks. If so, it could come about either by a movement towards investing in significant inter-disciplinary team-based research or by a substantial re-tooling of economic expertise and methodological sophistication. In any case, an essential part of this future investment, it seems to me, should be the design and implementation of many more observational and interview studies of the kind with which I began, but with a clear macroeconomic focus.

The future I envisage is goal-oriented actors in macroeconomic models who might trust or not trust what they think is happening at particular moments and, in the extreme case, withdraw funding or labour or break contracts or agreements, etc. We need to know how they are able to set wages, prices, output and interest rates in different conditions. We need to know how they respond to interest rates or fiscal changes and, potentially, to each other and shocks. We will also want to ask if, when and how they offer and accept contracts, strengthen or weaken trade unions, respond to the changing prices of imports, obtain more education or training, decide whether or not to work and, above all, if we take Keynes' perspective on its central role, we need to know when and under what conditions they make or postpone long-term decisions about when and how to innovate or to engage in capital investment.

Rather than relying on abstract propositions about how agents respond to each other when making investment decisions, implementing regulation, or taking into account central bank actions, we should find out. Do mortgage owners approach negative equity in the same way? By what processes do large companies decide when to make major investments in different economic conditions? Do firms, investors and consumers all make decisions on their own or after inferring the behaviour of other people? How would heterogeneity alter results (see for example, Hommes and Veld, 2017)? How can we tell what is happening in the economy at the moment? We should stop relying on arm chair assumptions about the economic behaviour of households or firms and how they view the future. Rather we should test and keep testing when and whether people insure or protect against employment, when they decide to work or go on strike, how far and in what way they learn from economic experience and adjust to different signals and whether and how they respond to changes in actual prices or perceived changes in prices, etc.

The assumption of global rationality and the assumption of risk rather than uncertainty has avoided the proper study of all these questions. The future needs to address them.

3. Conviction Narrative Theory (CNT)

Keynes (1936) critiqued his contemporaries' economic understanding by arguing that, given radical uncertainty, investment decisions cannot depend on strict mathematical expectation, 'since the basis for making such calculations does not exist' (p163). Rather, he argued, sufficient actors are usually able to 'supplement' and support reasonable calculation with 'animal spirits', and so to put aside thoughts '*of ultimate loss ... as a healthy man puts aside the expectation of death*' (1936 p162). Based on this idea, Keynes considered that the overall state of confidence in an economy would influence the willingness or not of individual decision-makers to commit to capital expenditure:

[I]f the animal spirits are dimmed and the spontaneous optimism falters, leaving us to depend on nothing but a mathematical expectation, enterprise will fade and die;—though fears of loss may have a basis no more reasonable than hopes of profit had before. (Keynes 1936, p162)

However, after Keynes, uncertainty gave way to calculable risk and animal spirits received little further attention or any systematic or theoretically worked out role.

CNT (Tuckett and Nikolic, 2017) is a new social-psychological theory of decision-making applicable to those situations in which economic agents must, whether they know it or not, satisfice (Simon, 1997)³ – that is they must make decisions although they cannot put probabilities on the likely outcomes of the decisions they make, the causal mechanisms that might produce those outcomes, or, indeed, know all of the options facing them. The questions are how do they manage it and with what consequences for the way they co-ordinate when their decisions are aggregated?⁴

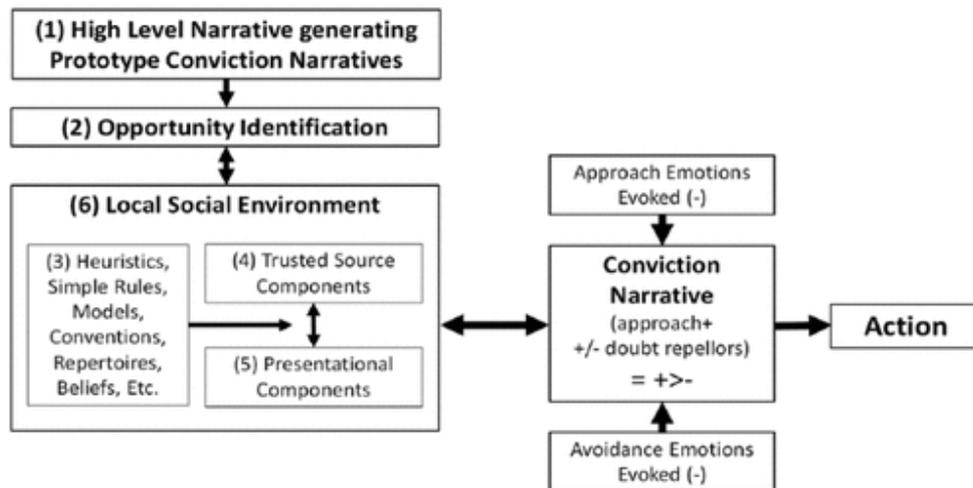
In CNT, in common with most social science and with recent understandings of perception and memory, knowledge of the world and of the action to take to influence it advantageously is not given as objective fact but *constructed subjectively in a social context* (Berger and Luckman, 1966). People act rationally in pursuit of their goals according to what they think will work –whether it will or not is quite another issue. So, actors are able to

³ “Satisficing, a blend of sufficing and satisfying, is a word of Scottish origin, which Simon uses to characterize algorithms that successfully deal with conditions of limited time, knowledge, or computational capacities. His concept of satisficing postulates, for instance, that an organism would choose the first object (a mate, perhaps) that satisfies its aspiration level--instead of the intractable sequence of taking the time to survey all possible alternatives, estimating probabilities and utilities for the possible outcomes associated with each alternative, calculating expected utilities, and choosing the alternative that scores highest.” (Gigerenzer and Goldstein, 1996. P651.)

⁴ See also King. 2016.

overcome any potential paralysis induced by the fact of radical uncertainty seen from outside, because they adopt conviction narratives (narratives they think accurate and feel are true) that are subjectively capable of supporting action because they manage both the anticipations of potential gain and loss associated with its consequences. I see it as a contemporary theory of

Figure 1 Selecting and Supporting Action (from Tuckett and Nikolic, 2017)



Keynesian *animal spirits*, based on the main thrust of recent research in brain and social science.

In CNT conviction narratives combine cognition and emotion to allow actors to interpret and make sense of data, to envision the future via narrative simulation and to approach, that is to support, action. Narratives that, overall, evoke attraction or *approach* feelings towards an action involving an investment (broadly conceived), support that action, provided emotions that evoke repulsion or *avoidance* of that course are less powerful in the overall feeling calculus. As represented in Figure 1 (below), actors develop particular conviction narratives by drawing on the beliefs, causal models and rules of thumb situated in their social environment and use them to identify opportunities worth acting on, to simulate the future outcome of those actions and to feel sufficiently convinced about the outcomes anticipated in the simulations to act⁵. Such narrative functions are founded on biologically and socially evolved coping capacities that have developed to allow individuals to prepare to execute particular actions even though they cannot accurately know what the outcomes will be. Narratives have the further function that they rationalise action in a socially efficient way and help actors to communicate and coordinate with others. Cognition combines with affect because of brain architecture. Brains initially developed from bodies and at the seat of the

⁵ Ideas about the role of simulation and embodied cognition that are central to the supportive role of narratives in decision-making build on existing work in affective and cognitive neuroscience (e.g. Suddendorf and Corballis, 2007; Barsalou, 2008; Damasio and Carvalho, 2013).

brain, so to speak, the interoceptive system sits evaluating perception and “thinking” in terms of basic homeostatic survival.

The theory is based on work in psychology such as the discussions by Bruner (1991) and Baumeister and Masicampo (2010) as to narrative as a fundamental form of human organisation having among its functions to organise thought.

The fact that approach and avoidance emotions are evoked by thinking during decision-making is a central idea in CNT. The idea is supported by significant advances in understanding the role of emotions in action and decision-making that have taken place in recent decades. They make it increasingly clear that emotion and cognition are not separate processes but intertwined at all stages from perception to action (Lerner et al, 2015; Phelps, 2006; Phelps et al, 2014). An important element of this new work has been the recognition of the importance of the fundamental relationship between emotion and approach/avoidance motivation and behavior at multiple levels from the primitive primary emotional system of the brain through learning processes to higher order cognitions (Panksepp, 2013; Rolls, 2013). Thus, not only base affective orientations but higher order emotions with complex cognitive appraisal elements may be understood as mechanisms for mediating approach behaviors to rewarding opportunities and avoidance behaviors in relation to aversive threats^{6,7}.

Economic actors making decisions based on CNT are very different to representative agents. They are, as evolved humans inherently social. They have developed to manage uncertainties in teams by looking around and looking at, or imagining, what others are doing. They develop conviction not through their ability to calculate future prices out to infinity but from the imaginative thoughts and feelings they subjectively develop about what they think

⁶ Note in passing that this is not entirely the same as traditional approaches to valance (negative versus positive emotions). For example, whilst anger is considered a negative emotion it is often associated with approach behaviors (Carver and Harmon-Jones, 2009), and whilst social approach motivation is associated with positive emotions at moderate levels, at high levels it may be associated with the negative emotions of separation distress (Harmon-Jones et al, 2013).

⁷ Whilst the question of the nature of the systems underlying approach and avoidance emotions, evaluations and behavior is by no means settled, there is significant empirical support for their centrality based in a reinforcement sensitivity theory conceptualization of an, approach related, behavioral activation system (BAS) and two avoidance systems the fight/flight/freeze system and the behavioral inhibition system. The behavioral activation system, is associated with emotions such as pleasant anticipation, excitement and elation but also with the anger arising from goal frustration. Associated approach behaviors include exploration in search of rewards and play as well as more direct approach to potential rewards. The fight/flight/freeze system (FFFS) associated with fear, panic and defensive anger, is sensitive to both conditioned and unconditioned aversive stimuli and underpins avoidance and escape behavior. The behavioral inhibition system (BIS) is responsible for the resolution of goal conflicts, particularly the need to approach potential reward in the face of aversive stimuli. BIS activates inhibition of both BAS and FFFS, engaging risk assessments, when detecting potential goal conflicts both in memory and the environment. The key mediating emotion for BIS is anxiety, which is a marker of unresolved goal conflict. Whilst extreme anxiety can be disabling, anxiety has an important function in promoting the necessary vigilance for detecting and resolving goal conflicts and in managing risks. Whilst immediate and intense threats in the context of goal conflict are primarily resolved through the FFFS, less intense (or more distant) threats in the context of potentially rewarding goals activate the BIS, hence the role of BIS may be more salient than the FFFS in the study of strategic decision-making. See Fenton-O’Creevey and Tuckett (forthcoming).

will work. It will be based on the narratives, rules of thumb and heuristics that have worked, or not, before and are felt convincing around them. They observe and think about the behavior of others they observe. Recall the Keynesian beauty case and the outcomes of repeat games. Economic actors engage in strategic interaction based on their narratives.

Clearly a system permeated by such economic actors is a very different one to that in standard macroeconomics, in which relationships are governed by prices. CNT agents are highly sensitive to change around them and may revise expectation or actions very quickly – joining in optimistic risk-taking or investing or rapidly responding to observed shifts in “animal spirits” to desist from doing so. Carlin and Soskice (2017) have recently applied the approach to understand how an economy can become trapped in a low-level investment equilibrium in one jump.

4. Analyzing News and Narratives to Understand and Forecast Macroeconomic Evolution.

Seventeen years ago, Shiller (2000) argued that significant market events “generally only occur if there is similar thinking among large groups of people, and the news media are essential vehicles for the spread of ideas”. In 2017, he elaborated his ideas and drew on a variety of literature to articulate how narratives can “go viral” and drive economic and financial fluctuations. He concluded by suggesting how textual and semantic analysis could be deployed as additional macroeconomic methods to help understand the impact of narratives (Shiller, 2017).

As just mentioned, in CNT decision-making at the micro level is easily influenced by shifts in macro-level shared narratives. Over the last few years, working particularly with Sujit Kapadia at the Bank of England, Rickard Nyman and I, along with Paul Ormerod and Robert Smith, have developed two approaches to measure shifts in macro-level narratives. We hypothesise, via CNT, that significant changes in the ratio of approach to avoidance evoking emotions in news relevant news narratives may, because they can causally influence individual agent conviction narratives and economic decision making, influence the level of animal spirits and so aggregate outcomes. We have described these approaches in detail elsewhere (Nyman et al, 2017; Tuckett and Nyman, 2017).

One measure, RSS (Relative Sentiment Shift) derives, very rapidly, a time series from any large corpus of text data to track changes in sentiment over time. Another measure (Consensus) derives a time series to track shifts in the degree to which the range of narrative

topics in a text corpus is moving in a more or less diverse direction. Movements towards there being more narrative topics suggests greater diversity of topics while movements in the opposite direction suggest more uniformity.

We use our Consensus measure along with a topic based RSS measure to assess changes relevant to the perception of risk-taking in financial markets (Tuckett, et al, 2014; Nyman et al, 2017). We use the RSS time series measure to assess whether sentiment changes in the direction of either approach or avoidance indicate likely changes in the direction of the economy towards a recession (Tuckett and Nyman, 2017).

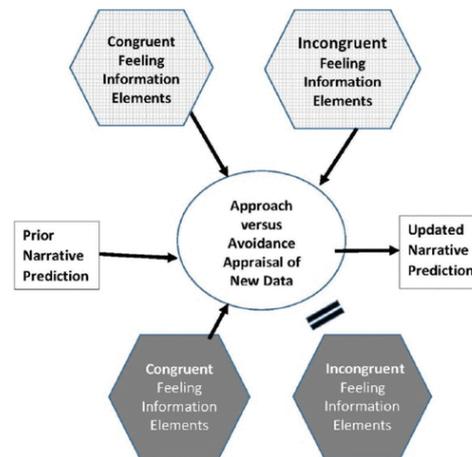
The construction of the measures, which have been used successfully to analyse three recent datasets (*Reuters News*, Bank of England of England internal commentary documents and Broker reports held at the Bank) and three historical datasets around the 1929 crash (*The Wall Street Journal*, *the New York Times* and *The Commercial and Financial Chronicle*) is described in detail elsewhere (Tuckett et al, 2014; Tuckett and Nyman, 2017, Nyman et al, 2017 and James et al, forthcoming), as are all the details of the econometric analysis and testing. All the analyses use the same “word-list” methodology for measuring the extent of approach and avoidance in documents. Some example words are in Table 1. Note, these are ordinary English emotion stimulating words.

Avoidance	Avoidance	Approach	Approach
Jitter	Erodes	Excited	Perfect
Threatening	Uneasy	Incredible	Win
Distrusted	Distressed	Ideal	Amazes
Jeopardized	Unease	Attract	Energizing
Jitters	Disquieted	Tremendous	Gush
Hurdles	Perils	Satisfactorily	Wonderful
Fears	Traumas	Brilliant	Attracts
Feared	Alarm	Meritorious	Enthusiastically
Traumatic	Distrusting	Superbly	Exceptionally
Fail	Doubtable	Satisfied	Encouraged

4.1 Financial Strain

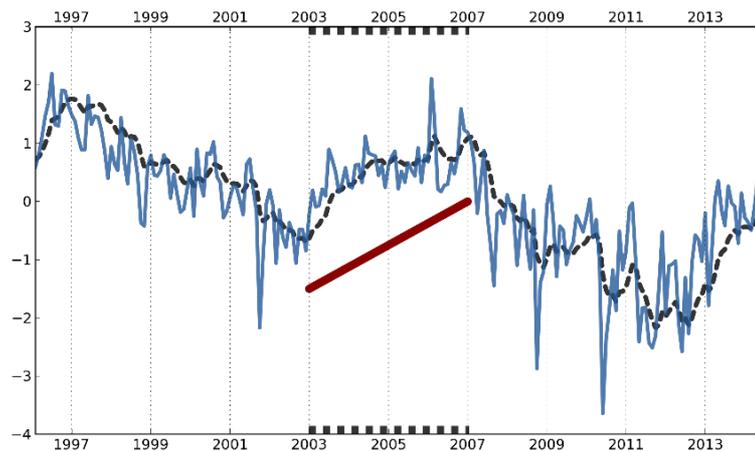
In CNT, agents build conviction narratives to support their actions. One question, therefore, is how they do that and in particular in what state of mind they do it. If they form and maintain their narratives in the Divided State (D^s) mental disposition mentioned earlier, then as Figure 2 illustrates, they will not update their narratives if new, contradictory information, becomes potentially available.

Figure 2 The influence of DS and IS states of mind on the likelihood new information felt incongruent will shift a preferred narrative.



We can suppose, given radical uncertainty and therefore the inevitability of the threat of loss or possibility of gain being omnipresent, that the proportion of approach to avoidance words in financial narratives around a particular if developed in an Integrated State (I^s) will tend to bobble around a mean. If so, then we can make use of this idea further to suppose that in an exuberant D^s of the kind that suggests a financial bubble, the proportion of approach to avoidance words in financial narratives around topics affected will tend to inflate over a significant period. Figure 3 shows exactly this development for articles in Reuters News that mention the word “liquidity” over the period 2002-2007 – a topic of possible relevance in the lead up to the final crisis, given the “this time is different” story about risk. Looking at 2012 to 2015 perhaps the same pattern is in play.

Figure 3 RSS around articles mentioning Liquidity in US Reuters

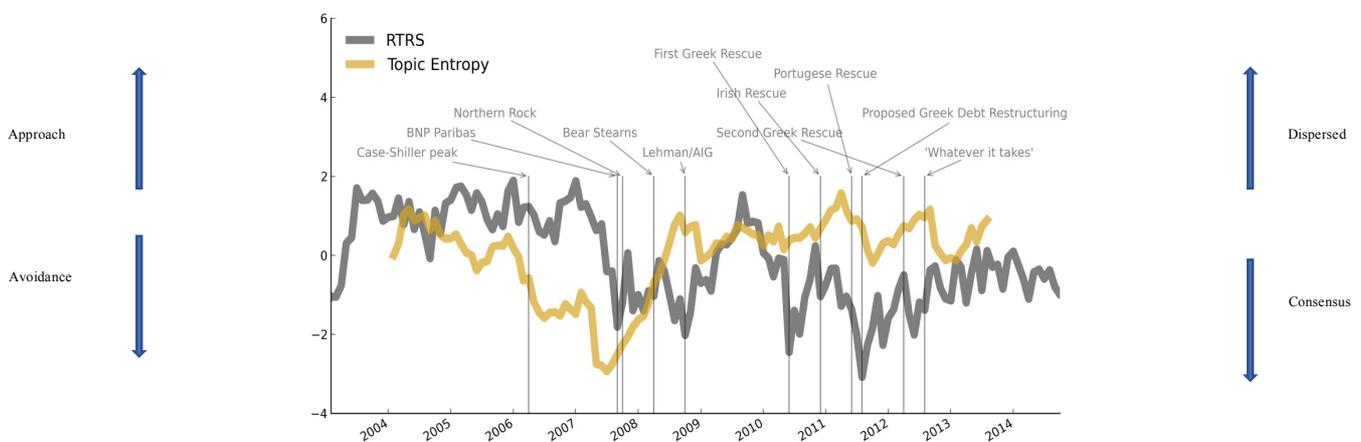


This analysis is *post hoc*. A future approach would be to use unsupervised machine learning techniques to identify (without prior selection) which topics of financial relevance

exhibit this type of approach-avoidance pattern and then use that information for forensic analysis.

A second method we can use to explore if conviction narratives are co-ordinating in a way indicative of a D^s is by combining an analysis of RSS evolution with a machine learning measure of topic consensus. This gives an intuitive representation of the increasing homogeneity of beliefs around a new paradigm prior to the crisis. If there is increasing consensus around narratives high in approach emotions and lacking avoidance ones (like anxiety) it is likely to be an important warning sign of impending financial system distress.

Figure 4 Topic Dispersal in UK Reuters

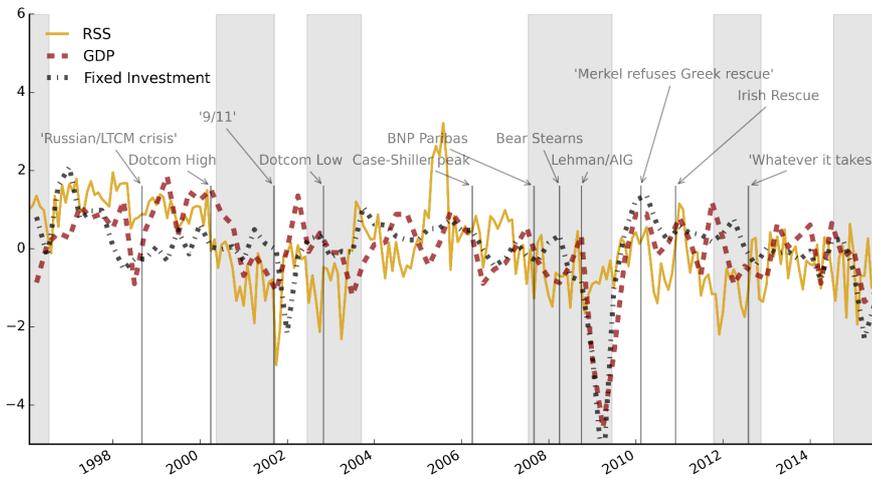


4.2 Macroeconomic Evolution: The influence of shifts in animal spirits on three economies.

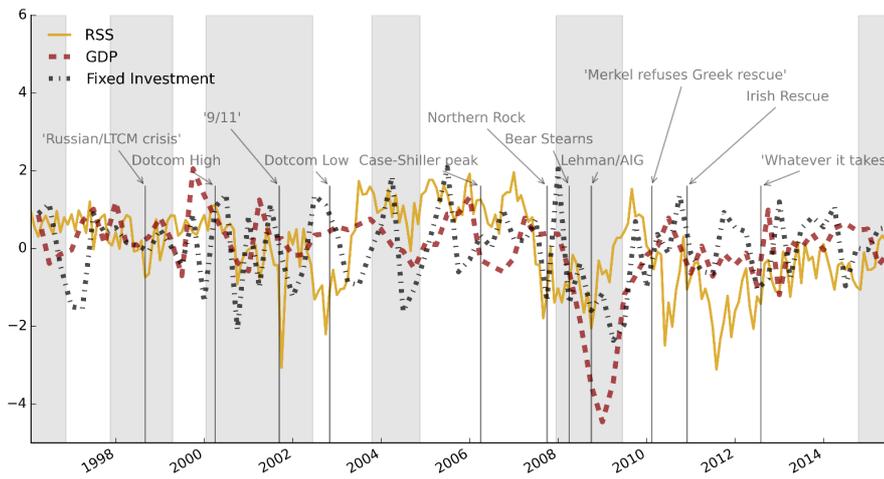
Figure 5 below, plots the monthly RSS time series for each of three major western economies against that country's quarterly change in GDP and Investment. We have annotated the charts with business cycle markers and key events for the particular country's economy but for purely illustrative purposes – in particular, unlike event studies, we do not try to infer anything causal from the events that we depict on the charts. Rather we want to show how each graph moves broadly as might be expected.

For Canada, we note that RSS and GDP move quite closely together. There is a significant drop in RSS after the dotcom high, after which RSS is volatile, until it appears to be influenced negatively by 9/11 and does not recover substantially until 2005. Next, we note the peak in the Case-Shiller housing index and a drop around the BNP Paribas event in mid 2007, signalling a freeze in credit markets. Falls in 2008 at the Lehman-AIG failures are clear and sentiment is clearly arrested in Spring 2010 when Germany refused to bail out Greece. There is a substantial recovery after Draghi's "Whatever it takes", followed by a flat period with persistent volatility.

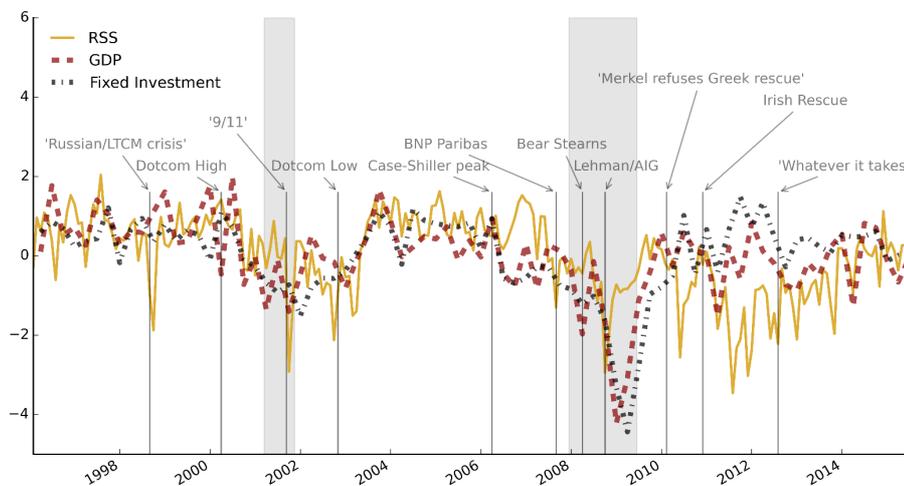
Figure 5 RSS, GDP and Investment for Canada, the UK and the US (1996-2015).



Canada



United Kingdom



United States

For the UK, RSS and GDP again move quite closely. The RSS line also moves broadly as might be expected. In particular, it shows a stable increase during the mid-2000s. This is followed by a large and rapid decline from mid 2007. The decline precedes the UK Northern Rock bail out and much of it occurs well before the US failure of Bear Stearns in March 2008. Strikingly, although this was already a period of turmoil in the financial system, the series hits very low levels before the worst parts of the crisis became evident just after the Lehman Brothers failure. The pick-up in 2009 rather clearly ends by the beginning of the Euro crisis, after which the series is volatile but fails to hit a sustained upward trend, like GDP.

For the US, RSS and GDP again move quite closely. We can note the rapid pick up in RSS in 1999 persisting until the dotcom crash. There is a temporary large drop at 9/11 and a fairly sustained downward trend until the dotcom low is reached. It picks up again in 2003 and with volatility stays at that level until a sharp drop early in 2007. A further very sharp drop takes place with the Lehman failure. Things then pick up early in 2009 but hit a significant derailment with the outbreak of the Euro crisis in March 2010. Unlike the Canadian economy and also, to a significant extent unlike the UK, there is then, with significant volatility, a steady RSS upward trend.

For the US, we have marked on the graph (shaded area) the two downward moves of the business cycles in this period, as defined by the NBER. For the UK and Canada, we mark the OECD defined business cycles. For all three countries, visual inspection suggests that RSS (ashift measure) and changes in GDP are quite closely coupled. RSS seems to fall into broad phases that perhaps anticipate changes in business cycles across all three economies – with falls in RSS in all three economies in Q3 and Q4 2007 being particularly striking, well before the falls in GDP that mark the beginning of the Great Recession, not forecasted by central banks until the second half of 2008⁸.

A fully robust conclusion (when multiple data points for both RSS and many business cycles are not available) is not possible. But to explore the impression RSS shifts precede major shifts in the business cycle, we tested for structural breaks in the three RSS time series, using the method of Bai and Perron (2003). The number of breakpoints m is estimated using Bayesian

⁸ The Anxious Index produced by the Federal Reserve Bank of Philadelphia (<http://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters/anxious-index/>), indicating the probability of a US recession in the next quarter, took values from 2007Q3 to 2008Q1 of 13.14, 14.00 and 16.95 respectively, indicating only a low probability. It was not until 2008Q2 that the value rose to 42.9.

Information Criterion (BIC) and their positions are estimated by minimising the residual sum of squares of the $m+1$ resulting line segments, fitting straight-line segments by minimising errors. In this setup, at least 15% of the data points must be in a segment. The analysis reveals 4 segments for each country. For Canada, the dates dividing the segments are February 2000, April 2003 and February 2007. For the UK it is June 2000, May 2003, and May 2007. For the US, it is August 2000, July 2003 and May 2007. The downward breaks in 2000 in all three economies coincide with the burst of the dotcom bubble. The upward breaks in 2003 precedes the subsequent recovery trend. 2007 then very clearly marks a dramatic downward negative shift in RSS in all three economies well before the Great Recession. Moreover, Table II, made possible by constructing additional RSS indices from other Reuters offices for a further five countries for whom Reuters news archive data was available in English⁹, confirms how unusual the 2007 breaks in the index actually are. For instance, if we compare RSS for individual quarters to the mean RSS levels between quarter 2 2003 and quarter 2 2007 for the European countries as well as for Canada, the UK and the US, the changes well ahead of 2008 in every economy are striking. There are drops of at least two standard deviations from the mean over the period for the UK, Spain and Ireland in Q2, drops of 2 standard deviations or much more for the US, UK, Germany, France and Spain in Q3. There are further unusual drops in Q4 and Q 1 2008 - all of these occurring well before the Lehman bankruptcy.

Table II Cross-Sectional Comparisons of RSS Shifts in 2007 and 2008

Number of standard deviations from the mean value over the period 2003Q2 through 2007Q2; US, UK, Germany, France, Spain, Sweden, Canada and Ireland

Country	2007Q1	2007Q2	2007Q3	2007Q4	2008Q1
US	-0.31	-0.91	-4.37	-3.54	-4.42
UK	0.28	-2.11	-6.52	-5.33	-6.33
Germany	-0.13	-0.12	-3.16	-1.84	-3.65
France	1.22	0.03	-2.59	-2.63	-4.38
Spain	-0.28	-2.56	-2.48	-2.09	-2.28
Sweden	0.27	-0.47	-0.76	-2.44	-3.20
Canada	-0.24	0.18	-1.91	-3.05	-4.06
Ireland	0.76	-3.21	-1.37	-1.31	-2.09

Note: 2 standard deviation moves in bold

We now turn our attention to a more formal analysis of the value of RSS.

RSS was developed with the idea that shifts upwards or downwards in the balance of approach and avoidance emotions in news narratives represented shifts in animal spirits and

⁹ The Reuters archive contains English language articles submitted from offices across the world. There were articles to derive RSS series for five more countries – Germany, France, Spain, Sweden and Ireland.

could be expected to have an influence on economic-decision-making insofar as the context for decision-making is uncertain and, therefore, to a degree dependent on “conviction narratives”. The hypothesis is that shifts in RSS, therefore, will influence economic variables for some distance out. To test this hypothesis formally, we first examine Granger causality between RSS and GDP for the three economies and then explore the effect of RSS on various macroeconomic variables in all three economies using a vector-autoregressive analysis (VAR).

a. Granger causality Tests

Visual inspection of the correlation between RSS and GDP suggest that changes in RSS often precede those in GDP. Here we test for the existence of granger causality between quarterly levels of RSS and GDP growth for each of the three countries: US, UK and Canada.

We estimate VAR models with GDP growth and RSS for the period January 1996 through July 2015. We select the lag order of the VAR using the Akaike Information Criterion (AIC). We add lags to account for non-stationarity of either series (add lags equaling the maximum order of integration of GDP growth and RSS). Wald tests are performed on the lags in the VAR. Table III summarizes our results.

	GDP from RSS	GDP to RSS	I from RSS	I to RSS
UK	0.41	0.24	0.69	0.071*
US	0.007***	0.85	0.03**	0.1
CA	0.29	0.28	0.036**	0.91
Note:	*p<0.1; **p<0.05; ***p<0.01			

For the UK, AIC gives 1 lag in both VARs. Both series are I(1). Fit VAR(2) models in both cases. Wald test restricting 1 lag in each VAR. The p-value of the causality test from RSS to GDP is 0.41. The p-value of the causality test from GDP to RSS is 0.24 and to Investment 0.69. We can establish no Granger causality from RSS but a slight tendency in the opposite direction.

For the US, AIC gives 2 lags in the VAR with GDP growth and 1 lag with Investment. Both series are I(1). Fit VAR(3) and VAR(2) models respectively. Wald test restricting 2 or 1 lag in the VAR respectively. The p-value of the causality test from RSS to GDP is 0.007 and from RSS to Investment is 0.03. The p-value of the causality test from GDP to RSS is 0.85 and from Investment to RSS 0.1. There is Granger causality for both GDP growth and Investment.

For Canada, AIC gives 1 lag in both VARs. Both series are I(1). Fit VAR(2) models in both cases. Wald test restricting 1 lag in each VAR. The p-value of the causality test from RSS

to GDP is 0.19 and to Investment, it is 0.036. The p-value of the causality test from GDP to RSS is 0.32 and from Investment to RSS is 0.91. We find Granger causality for Investment but not GDP.

We can conclude that RSS granger causes US GDP and US and Canadian Investment and that there is only one small relationship in the other direction.

b. VAR Models

Economic relationships are complex theoretically and, in any case, testing models against reality is always difficult. Vector Autoregressive or VAR models are one approach although as Baker et al (2016) pointed out, drawing causal inferences from such procedures remains challenging. That said, we use their approach to characterize the dynamic relationships in the economy and to ask whether the RSS series appears to foreshadow stronger or weaker macroeconomic performance conditional on standard macro and policy variables.

We start by fitting a VAR to monthly data from each country January 1996 to July 2015. To recover orthogonal shocks, we use a Cholesky decomposition with the following ordering: RSS, the log of the relevant stock price index, official interest rate, log employment, and log industrial production. We also test the stability of the impulse responses by ordering RSS last in the VAR.

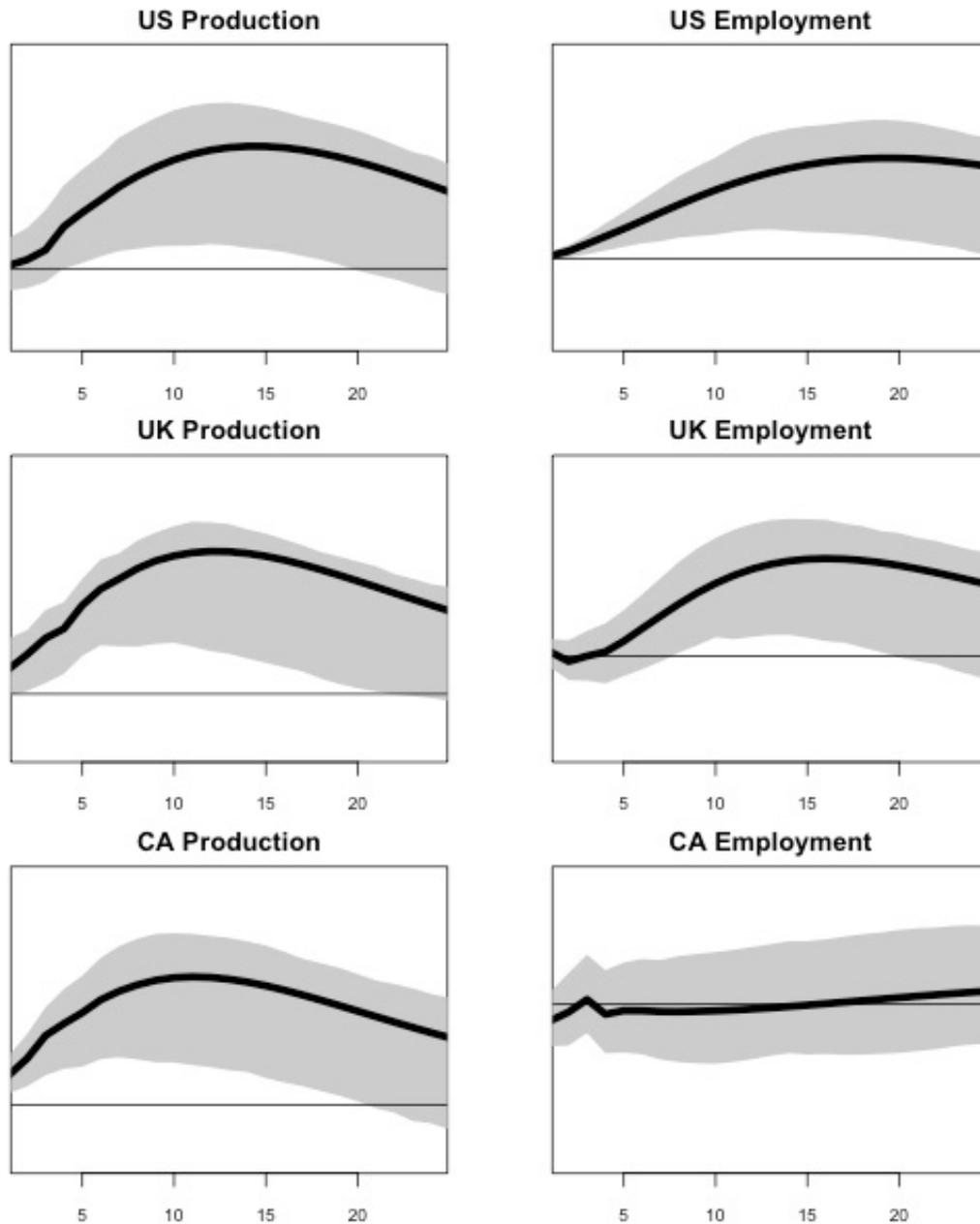
Figure VI (overleaf) shows the impulse response of RSS on IP and Employment, for the US, UK, and Canada, respectively.

For Canada, changing the order of the variables and placing RSS last instead of first does not change the impulse response. We can conclude that RSS has a significant impact on industrial production. The effect lasts for almost 17 months. However, there is no significant impact on employment.

For the UK, changing the order of the variables and placing RSS last instead of first does not change the impulse responses. We can conclude that RSS has a significant impact on both industrial production and employment. In the case of IP, the effect lasts for almost 20 months.

For the US, changing the order of the variables and placing RSS last instead of first does change the impulse responses. We have, therefore, somewhat weaker evidence in the US VAR model than the UK equivalent.¹⁰

Figure VI Estimating VAR models: the impulse response of RSS on IP and Employment, for the US, UK, and Canada



The VAR models suggest RSS has a significant impact on all three economies so the hypothesis that RSS contains useful information is supported. Of interest, also, is the relation of the RSS

¹⁰ This result is anomalous because Baker et al (2016) report that altering the order does not reduce the effect of the EPU. When we look at the EPU in the VAR model over our period (beginning 1996) rather than their period (beginning 1985) the effect of changing the order is more detrimental to the influence of the EPU than RSS. Unfortunately, we don't have Reuters data for 1985 to 1996 to test RSS over that period.

series to other variables often used to monitor sentiment, such as the ordinary version of the Michigan Consumer Confidence Index (MCI) and the adapted E5Y version (used by Barsky and Sims (2012) to explore animal spirits) and the Economic Policy Uncertainty index produced by Nick Bloom and his group (Baker et al, 2016). Table IV shows that RSS clearly Granger causes the three other variables.

Table IV: Granger Causality between RSS, the EPU, E5Y and the MCI

	From RSS	To RSS
EPU	7.1e-06***	0.054*
E5Y	0.087*	0.63
MCI	0.019**	0.84
Note:	*p<0.1; **p<0.05; ***p<0.0	

Perhaps in line with the expectation that there are likely to be complex feedback effects between sentiment, economic outcomes and the subjective experience of uncertainty, there is a small relationship between the EPU measure and RSS.

5. Conclusion

In this paper, I have set out an argument that macroeconomic models could advantageously drop the assumption that economic actors are able to know what is going on in the economy to the extent it removes radical uncertainty about the actions of any proposed actions. Instead of the distinction between rational and irrational (or behavioural), I have suggested that instead we need to incorporate a theory of rational action which takes account of what we know about the way human sentient and social actors take decisions under radical uncertainty. I have suggested that a lot of highly targeted ethnographic research would be valuable and also proposed a high-level theory of narrative decision-making that may be useful. I have also described applications of the theory which show some promise in the very hard area of macroeconomic forecasting – an area which given radical uncertainty, one could not expect to be other than complicated.

Preparing for this panel our moderator asked how, given the unreality of underlying assumptions, conventional DSGE macroeconomics could have been and remain been so influential. One answer, provided by my fellow panellist, John Muellbauer, is incentives. John referred to the system of academic reward and the groupthink enforced by the 5-journal oligopoly. I don't disagree. Nonetheless, I believe the groupthink many have identified has a

deeper route in anxiety and a fear of loss of an impression of omniscient control, as groupthink generally does.

Central banks and other clients of macroeconomic models need to take decisions in radical uncertainty. They can develop their conviction narratives to support these decisions in an integrated state or a divided state. Until now at least, insofar as they chose to rely on DSGE type models, there seems to have been a clear preference for a divided state: to select a wrong model rather than to suffer the anxiety and challenges to their authority which might derive from having no empirically validated model at all. If so, it aligns with the findings of my colleague and co-investigator Lenny Smith from LSE. He has found that about half the senior level managers and CEOs challenged to make long-range decisions impacted by climate would prefer to have model predictions of future weather impacts that are known to be misleadingly inaccurate, rather than not (N~40). The difference comes with weather forecasters. Nearly all weather forecasters asked (N~100) value no model-based statements about the far future to a detailed pronouncement from an inaccurate model. What will be the future among economists?

References

- Bai, J. and Perron, P. (2003), Computation and analysis of multiple structural change models. *J. Appl. Econ.*, 18: 1–22. doi:10.1002/jae.659
- Baker, S. R., Bloom, N., and Davis, S. J. (2016). ‘Measuring Economic Policy Uncertainty’, *Quarterly Journal of Economics*, 131(4), pages 1593-1636.
- Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology*, 59, 617–645.
- Barsky, Robert B and Sims, E.R. (2012). "Information, Animal Spirits, and the Meaning of Innovations in Consumer Confidence." *American Economic Review*, 102(4): 1343-77. DOI: 10.1257/aer.102.4.1343
- Baumeister, R. F., and 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.
- Beckert, J., and Aspers, P., (2011) *The Worth of Goods*. Oxford, Oxford University Press.
- Berezin, M. (2005). Emotions and the economy. In N. J. Smelser and R. Swedberg (Eds.), *Handbook of economic sociology* (2nd ed., pp. 109–127). New York, NY: Russell Sage Foundation.
- Berger, P., and Luckman, T., (1966) *The Social Construction of Reality - Everything that passes for knowledge in society*. London: Allen Lane, The Penguin Press.
- Bewley, T (1999) *Why Wages Don't Fall During a Recession*, Harvard, Mass: Harvard University Press
- Bruner, J. (1991). The Narrative Construction of Reality. *Critical Inquiry*, 1-21.
- Carlin, W., and Soskice, D., (2017) Stagnant productivity and low unemployment: Stuck in a Keynesian equilibrium. (Forthcoming)
- Carver, C. S., and Harmon-Jones, E. (2009). Anger is an approach-related affect: evidence and implications. *Psychological bulletin*, 135(2): 183.
- Damasio, A., and Carvalho, G. (2013). The nature of feelings: Evolutionary and neurobiological origins. *Nature Reviews Neuroscience*, 14(2), 143–152.
- Esposito, E., (2016) Predicted Uncertainty. Volatility Calculus and the Indeterminacy of the Future. Conference on Economic Futures: Imaginaries, Narratives, and Calculation. Max Planck Institute for the Study of Societies and Sciences Po Paris, 17-18 March 2016.
- Fenton-O’Creevey, M., and Tuckett, D., (Forthcoming) Strategic decision-making and action under conditions of radical uncertainty: a conviction narrative approach.
- Gigerenzer, G. (2008) *How People Cope with Uncertainty* (Evolution and Cognition Series). Oxford. Oxford University Press.
- Gigerenzer, G., and Goldstein, D., (1996) Reasoning the Fast and Frugal Way: Models of Bounded Rationality. *Psychological Review*, 103, 650-669.
- Guillén, M. F., Collins, R., and England, P (2003) (eds) *The New Economic Sociology*. New York: Russell Sage Foundation.
- Harmon-Jones, E., Harmon-Jones, C., and Price, T. F. (2013). What is Approach Motivation? *Emotion Review*, 5(3): 291-295.

- Hommes, C., and in 't Veld, D. (2017). Booms, busts and behavioural heterogeneity in stock prices. *Journal of Economic Dynamics and Control*, 80, 101-124. DOI: 10.1016/j.jedc.2017.05.006
- James, H., Kabiri, A., Nyman, R., and Tuckett, D., (2017). Sentiment Shifts and the Great Depression. In preparation.
- Keynes, J.M. (1936). *The General Theory of Employment, Interest and Money*. Palgrave Macmillan.
- King, M., (2016) *The end of alchemy: Money, banking and the future of the global economy*. London, UK: Little Brown.
- Knorr Cetina, K., and Preda, A., eds. (2005) *The sociology of financial markets*. Oxford: Oxford UP.
- Krugman, P (2009) Book Review: *Keynes: The Return of the Master* by Robert Skidelsky. *The Observer*. Lodo, Sunday August 30th.
- Lane, D., and Maxwell, R. R. (2005). Ontological uncertainty and innovation. *Journal of Evolutionary Economics*, 15(1), 3–50.
- Lerner, J. S., Li, Y., Valdesolo, P., and Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology*, 66.
- Mankiw, N.G., (1999) *The Reincarnation of Keynesian Economics*. NBER Working paper no. 3885.
- Nyman, R., Gregory, D., Kapadia, S., Smith, R., Tuckett, D., and Ormerod, P. (in press). News and narratives in financial systems: Exploiting big data for systemic risk assessment. Presented at the NBER Summer School 2017. Bank of England Working Papers Series (forthcoming). Available at http://conference.nber.org/confer//2017/SI2017/EFFE/Nyman_Gregory_Kapadia_Ormerod_Nyman.pdf.
- Panksepp, J. (2013). Cross-species neuro-affective parsing of primal emotional desires and aversions in mammals. *Emotion Review*, 5(3): 235-240.
- Parsons, T., (1937). *The Structure of Social Action*. Vol 1. Paperback Edition 1968. New York: The Free Press.
- Phelps, E. A. (2006). Emotion and cognition: insights from studies of the human amygdala. *Annu. Rev. Psychol.*, 57: 27-53.
- Phelps, E. A., Lempert, K. M., and Sokol-Hessner, P. (2014). Emotion and decision making: multiple modulatory neural circuits. *Annual Review of Neuroscience*, 37: 263-287.
- Rolls, E. T. (2013). What are emotional states, and why do we have them? *Emotion Review*, 5(3): 241-247.
- Shiller, R (2000). *Irrational Exuberance*. Princeton University Press.
- Shiller, R (2017). 'Narrative economics', *Cowles Foundation Discussion Paper*, Number 2069.
- Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, 69, 99–118.
- Simon, H.A., (1997) *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organizations*. 4th ed. Original edition 1947. New York: The Free Press

- Soros, G. (1987). *The Alchemy of Finance*. New York, NY: Wiley and Sons.
- Suddendorf, T. and 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.
- Sull, D., and Eisenhardt, K. M. (2015). *Simple rules: How to thrive in a complex world*. London, UK: John Murray.
- Tuckett, D. (2011). *Minding the Markets: An Emotional Finance View of Financial Instability*. Palgrave Macmillan.
- Tuckett, D. (2012). Financial markets are markets in stories: Some possible advantages of using interviews to supplement existing economic data sources. *Journal of Economic Dynamics and Control*, 36, 1077–1087.
<http://www.sciencedirect.com/science/article/pii/S0165188912000851?via%3Dihub>
- Tuckett, D.A and Nikolic, M., (2017) The Role of Conviction in Decision-Making Under Radical Uncertainty. Available open access on
<http://journals.sagepub.com/doi/full/10.1177/0959354317713158>
- Tuckett, D., and Nyman, R., (2017) The Relative Sentiment Shift Series for Tracking The Economy. (Under Review). Available at
https://www.researchgate.net/publication/316923347_THE_RELATIVE_SENTIMENT_SHIFT_SERIES_FOR_TRACKING_THE_ECONOMY/stats
- Tuckett, D., Smith, R. E., and Nyman, R. (2014). Tracking phantastic objects: A computer algorithmic investigation of narrative evolution in unstructured data sources. *Social Networks*, 38, 121–133.
<http://www.sciencedirect.com/science/article/pii/S037887331400015X>
- Vuori, T. O., and Huy, Q. N. (2016). Distributed attention and shared emotions in the innovation process: How Nokia lost the smartphone battle. *Administrative Science Quarterly*, 61(1): 9-51.