Uncertainty and Economics

"Essential reading for everyone who is willing to take 'uncertainty' in economics seriously!"

Prof. Dr. Joachim Güntzel, Baden-Württemberg Cooperative State University, Ravensburg, Germany

This book is set against the assumption that humans' unique feature is their infinite creativity, their ability to reflect on their deeds and to control their actions. These skills give rise to genuine uncertainty in society and hence in the economy. Here, the author sets out that uncertainty must take centre stage in all analyses of human decision making and therefore in economics.

Uncertainty and Economics carefully defines a taxonomy of uncertainty and argues that it is only uncertainty in its most radical form which matters to economics. It shows that uncertainty is a powerful concept that not only helps to resolve long-standing economic puzzles but also unveils serious contradictions within current, popular economic approaches. It argues that neoclassical, real business cycle, or new-Keynesian economics must be understood as only one way to circumvent the analytical challenges posed by uncertainty. Instead, embracing uncertainty offers a new analytical paradigm which, in this book, is applied to standard economic topics such as institutions, money, the Lucas critique, fiscal policy and asset pricing.

Through applying a concise uncertainty paradigm, the book sheds new light on human decision making at large. Offering policy conclusions and recommendations for further theoretical and applied research, it will be of great interest to postgraduate students, academics and policy makers.

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2 Uncertainty in economics

2.1 The origins of uncertainty

2.1.1 The main assumption

At the heart of uncertainty lies an agnostic demon. "We just don't know" postulated Keynes. Science, however, is about learning and understanding, which is pretty much the opposite of not knowing. No wonder, therefore, that Keynes' dictum is prone to be ignored or circumvented in more or less elegant ways.

Not accounting for uncertainty may, however, result in severe confusion about what we do indeed understand about the economy. In the financial crisis of 2007/2008 the demon has lashed out at this ignorance and challenged the credibility of the whole economic community by laying bare economists' incapability to prevent the crisis.

This book's main assumption is that humans cannot be emulated by other humans, not with even the most sophisticated machines. This assumption is based on the observation and experience of limitless human creativity as it is witnessed not only by collections of art and libraries full of genuine contributions to science, poetry, music and literature but also by daily life encounters of conversations of humans where literally no single exchange is a copy of the past. We will use these

observations to induce a principle of genuine individualism to all human thinking and decision making.

It is, of course, no coincidence that this principle also pertains to the methodological individualism that every first-year student of economics is made familiar with. It essentially maintains that all individuals have their own preferences, judgements and desires. Likewise, the humanist approach that no human is worth more or less than any other human but equipped with the same rights to live and prosper may also be quoted as supportive for the main assumption. For reasons that will become apparent later, we nevertheless emphasize the fact that our main assumption is an induced working hypothesis derived from experience.

A first and very important implication thus immediately follows: no matter how hard one tries, it is impossible to "form groups of instances" of humans that would completely describe all of these humans' properties, neither in deterministic nor in stochastic terms. This is not to say that some properties such as body height or purchasing propensity could not be inferred under very specific circumstances. But it is to say that humans always possess the ability to change themselves–their wants, needs, preferences, their fate.

Another striking implication derives by contradiction. Under our main assumption the so-called singularity (Good, 1966; Vinge, 1993) in artificial intelligence (AI) does not exist. This "singularity" is the moment at which machines become conscious of themselves and thereby turn into what some fear as being some kind of super-humans. Now, let us consider two possibilities. For one, let us assume that this singularity might occur at some time in the future. If we make this assumption, there would be no way of denying that this point has not already occurred in the past and that we, the human race, are the product of some machine that gained consciousness at some moment long past. Only by assuming that this AI-singularity does not exist can we maintain our main assumption that it is not possible to emulate humans by other humans, not with even the most sophisticated machines.

For the time being, we will work with this hypothesis until proven wrong.[1] At the same time, this is not to say that machines may not be superior in accomplishing certain tasks, such as playing Chess or Go, for example. The crucial difference the main assumption implies is that humans are capable of idiosyncratic creativity.

2.1.2 Uncertainty: a human trait

Human creativity does not only enable men to recognise their environment and deduce its properties, it foremost equips them with actually shaping and making their world. There are at least two important processes by which humans create the not-knowable as opposed to stochastic events.

The first process may be called reflexivity (Soros, 2013). Reflexivity relates to the fact that humans form views and models about facts and events that "can influence the situation to which they relate through the actions of the participants"

(Soros, 2013, p. 310).[2] Though it may seem as if this ability is exactly what made Robert Lucas come forward with his critique of the macroeconomic modelling of his time, the consequences are reaching far beyond what is covered by model-consistent expectation formation.

The Lucas critique demands that economic modellers account for the implied outcome of agents' actions (policy conduct) at the very outset. True reflexivity expands Lucas' argument beyond the boundaries of any model. The reason is again twofold. First, unless literally every single human uses exactly the same model up to some stochastic variation, the individual responses will differ in an unpredictable manner. The main assumption rules out purely random variations of the model across all individuals. However, ruling out random variations of the model also rules out random model consistent responses. Therefore, the outcome would be not-knowable. To turn the argument around, only if it was possible to somehow force all agents to subscribe to a certain model or certain type of model, model-consistent behaviour of all agents (up to some stochastic variation) can be expected. As we will see below, this subscription seems very unlikely when considering that economic interaction is not equivalent to planets and atoms flying through time and space.

Second, reflexivity also implies that humans can question the model itself. Being jailed behind the bars of a particular model that rules essentially all options is not the way to operate a profitable business in the long run.[3] In contrast to an object falling off some height forced by the inevitable laws of gravity, agents will relentlessly challenge the very rules of the game, especially if the current rules lead to a crash. Therefore, while a falling object cannot but "wait" until the moment of impact, humans would try to change the law of gravity. They are able to do so because the rules of business and economics at large are a far cry from natural laws, but institutions that are meant to be amended if needed to. Again, the direction of amendment depends on the properties of the humans involved, and since they are genuinely individualistic by assumption, this direction is, in principle, not predictable.

The second process is transformativity. Transformativity means that economists and economic agents at large constantly change the object of economic analysis. Transformativity can therefore be regarded as the other side of the positivist coin. It is very close to pure irony that the influential advocate of positivism in economics, Milton Friedman, was also a major transformist. There are at least two remarkable achievements of his that illustrate this point. The first one is the general move from fixed to flexible exchange rates. Friedman's article "The case of flexible exchange rates" exercised an enormous influence not only on economists but also on policy makers as it delivered the scientific pretext of abandoning the Bretton Woods system. Tellingly, this article appeared as one of his "Essays in positive economics" but the analysis quickly assumed a de-facto normative character and eventually helped inspire the rise of the era of flexible exchange rates. In other words, economics itself can, at least partly, be considered "An engine, not a camera", as MacKenzie (2006) argues.

MacKenzie (chap. 6) further cites yet another well-known example of economic transformativity. According to him, Friedman delivered a commissioned scientific analysis that argued for the need to establish a market for foreign exchange futures which later became the International Monetary Market of the Chicago Mercantile Exchange.[4]

Examples for the transformative nature of economics abound: the publication of the Black-and-Scholes formulae pushed wildly fluctuating option prices into a comparably narrow range around their theoretically "true" values (MacKenzie, 2006, p. 165). Money, too, is *constituted* only by the actual use of coins, notes, bits and bytes as money. There can be no abstract object that serves as money without people turning it into money by using it.

Most significantly, transformativity is, of course, also evident in the focal object of economic analysis: markets. Markets are nothing but the result of human ingenuity. Therefore, market prices, for example, are first of all the result of human imagination and can hardly be assumed to obey natural laws.

Consequently, economics itself cannot be regarded a purely analytical science. It has the amazing and exciting property of shaping the object of its own analysis. This feature clearly distinguishes it from physics, chemistry, archaeology and many other sciences. While biologists, chemists, engineers, physicists and many more are very well able to transform whole societies by their discoveries and inventions – like Penicillin or the internet – the laws of nature they study remain unaffected by these inventions.[5] In economics, this constancy of the object under study just does not exist.

Transformitivity, however, is not restricted to economics as a science. Any agent in the economy and as such the object of study of economists has the power to transform the economy; some to a greater, some to a lesser extent. As an example, consider that a key ingredient of the financial crisis was the invention of the so-called securitisation of assets, their slicing and repackaging. This invention was the brain child of some creative agent who thus expanded the rules of the mortgage and other credit markets. The world-wide spread of that instrument and similar ones eventually led to the enormous, largely undetected correlation of risk exposures that narrowly crashed the world financial market. For economists especially it is straightforward to see that there were strong incentives for coming up with an invention of this profit-expanding kind. Yet despite understanding this pattern, most economists were ill-equipped to precisely predict the innovation or its later impact on the economy.

In a nutshell, human creativity systematically and unpredictably creates and changes the very scientific object economists are set to analyse: the economy and its laws of motion. By the main assumption that humans cannot be emulated it becomes clear that the very nature of humans, therefore, generates the not-knowable and hence uncertainty as a distinct and undeniable feature of society and, therefore, of the economy. Any neglect of uncertainty in economic modelling and economic analysis at large thus bears the potential of grave analytical mistakes if not scientific oblivion.

Thankfully, psychologists and economists have already identified a great number of factors that are related to $c - c'$. Assuming, for example, that humans have been faced with uncertainty ever since they have populated the earth, humans probably have developed efficient strategies to cope with it. It is therefore a matter of taste to refer to these empirical identifications as an evolutionary approach. Researchers, in turn, uncover those strategies and, potentially, improve upon them.

Without claiming completeness, the following list provides some of them. For reasons that will be explained below, we will call this list "decision enabling factors":

- emotions (Damasio, 1995; 2012)
- anchor values (Kahneman, Schkade and Sunstein, 1998)
- endowment (Tversky and Griffin, 1991)
- institutions
- belief
- credible information (Druckman, 2001)
- status quo (Samuelson and Zeckhauser, 1988)
- heuristics (Goldstein and Gigerenzer, 2002)
- uncertainty aversion (Ellsberg, 1961)
- inattention (Bacchetta and van Wincoop, 2005)
- deliberate ignorance
- science
- whim (Keynes, 1936, pp. 162–163)
- sentiment (Keynes, 1936, pp. 162–163)

- chance (Keynes, 1936, pp. 162–163)
- prejudice

In the presence of uncertainty these factors are not merely "explainawaytions" (Thaler, 2016, p. 1582) or stains on an otherwise-perfect *homo economicus*. Rather, they are indispensable tools for making decisions in most circumstances because they help to bridge the gap between the not-knowable outcome of a certain choice and its utility for the individual.

A striking example that underlines the importance of emotions, for instance, is owed to Damasio (1995). Damasio tells the story of a patient called Elliot who had lost parts of his brain due to a surgery that removed an aggressive brain tumour. Crucially, however, with the tumour some frontal lobe tissue of the brain had also be to be removed. This region of the brain is known to be the region where emotions are controlled.

The operation was a "success in every respect", Damasio (1995, p. 36) reports and adds, "To be sure, Elliot's smarts and his ability to move about and use language were unscathed". It later turned out that he also did well in standard tests of cognitive skills and analytical problem solution. And yet, something peculiar had changed:

> He needed prompting to get started in the morning and prepare to go to work. Once at work he was unable to manage his time properly; he could not be trusted with a schedule. […] One might say that the particular step of the task at which Elliot balked was actually being carried out *too well*, and at the expense of the overall purpose.
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> Damasio (1995, p. 36), emphasis as in the original

Elliot, moreover, showed "superior scoring on conventional tests of memory and intellect" which apparently "contrasted sharply with the defective decision-making he exhibited in real life", (Damasio, 1995, p. 49). Even more strikingly, Elliot was very well aware of himself and his excellence at testing as well as of his inability to cope with real life. Damasio (1995, p. 49) gives the patient's own account of his situation as follows.

> At the end of one session, after he had produced an abundant quantity of options for action, all of which were valid and implementable, Elliot smiled […] but added: "And after all this, I still wouldn't know what to do!"
>
> Damasio (1995, p. 49)

It might be noteworthy that Elliot seemed to command all the required skills, knowledge and wits of a rational man, quite like economists imagine the perfect decision maker. But still, he was not up to the challenge of being a functioning member of society.

This dis-functionality shows as an inability to choose, as Damasio (1995, p. 50) observes: "The defect appeared to set in at the late stages of reasoning, close to or at the point at which choice making or response selection must occur. […] Elliot was unable to choose effectively, or he might not choose at all, or choose badly."

What is probably most remarkable of all is the underlying reason Damasio discovers for Elliot's behaviour. Damasio (1995, p. 51): "I was certain that in Elliot the defect was accompanied by a reduction in emotional reactivity and feeling. [. . .] I began to think that the cold-bloodedness of Elliot's reasoning prevented him from assigning different values to different options, and made his decision-making landscape hopelessly flat."

After having studied twelve patients with similar damages to frontal lobe tissue and similar changes in personality that turned individuals from affectionate, emotional beings into rather "cold-blooded" rational men, Damasio (1995, p. 53) summarizes that in none of the twelve cases "have we failed to encounter a combination of decision-making defect and flat emotion and feeling. The powers of reason and the experience of emotion decline together."

There still remains one riddle to be resolved. How is it possible that a smart, knowledgeable man does perfectly well in the laboratory but still cannot prevail in life? Damasio's (1995) simple answer is: uncertainty.

> Even if we had used tests that required Elliot to make a choice on every item, the conditions still would have differed from real-life circumstances; he would have been dealing only with the original set of constraints, and not with new constraints resulting from an initial response. [. . .] In other words, the ongoing, open-ended, **uncertain evolution** of real-life situations was missing from the laboratory tasks.
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> Damasio (1995, p. 49f), emphasis added

Thus, once we shift the focus of the analysis of decision making away from laboratories (and mathematical models) to real-life problems where decisions have to be made under uncertainty, *emotions* apparently do not impair but *enable decisions*. In the words of Damasio (1995, p. 49f): "***Reduction in emotion may constitute an [. . .] important source of irrational behavior***" (bold face and italics in the original).

Using the above notation, it seems that Elliot had lost his ability to make decisions using d_u but retained d_r. When going through standard testing procedures, d_r was fully sufficient for gaining high scores but these scores were meaningless, when d_u was needed in real life and hence under the conditions of uncertainty. It follows that emotions are an essential, distinctive element of d_u that is not part of d_r.

To sum up, emotions *enable* decision making; they are not merely confounding factors or causes of "irrational" behaviour. Quite to the contrary, emotions are a pre-condition for rational choice under the conditions of uncertainty.

2.4.1 Puzzles

Kuhn (1970) notes that the accumulation of unresolvable puzzles pre-dates the shift to a new paradigm. Economics, it seems, is an exception to this rule because the discovery of a new puzzle is often not necessarily considered evidence against, but in favour of, the validity of the prevailing paradigm. This view is fuelled by the prospect of high-ranking journal publications when "discovering" (and nurturing) puzzles. Attending to puzzles, one might even think, is more useful for economists than their eventual resolution because only unresolved puzzles afford continued intellectual discussions and career prospects. It is therefore enlightening to understand the nature of puzzles in economics.

Looking at canonical economic puzzles (Meese and Rogoff, 1983; Obstfeld and Rogoff, 1995; Engle, 1996; Taylor, 1995; Obstfeld and Rogoff, 2000) it is straightforward to see that puzzles in economics share a common key feature at large. This common feature is their underlying structure, which is characterised by two mutually contradicting stances.

The first of them rests on the paradigmatic pillars of contemporary economics comprising general equilibrium, subjective rationality, individual utility maximisation and risk. We have already seen above that rational expectations is short-hand for subjective probability and individual utility maximisation under general equilibrium and risk. In what follows, we therefore do not refer to these deeper concepts individually but to rational expectations as their aggregate for the sake of simplicity. Rational expectations in conjunction with the economic hypothesis of interest eventually lead to conclusions about the theoretical features of economic phenomena such as prices and quantities.

The second, contradicting, stance is derived from empirical observations. Empirical research consistently shows that the theoretical features of economic phenomena derived from rational expectations are not in line with actual data. This is true especially for those markets where stakes are the highest and where rationality should yield the largest pay-offs.

For example, foreign exchange rate models are famous for their various failures, usually dubbed puzzles, such as the difficulties in predicting spot rates by forward rates (Wang and Jones, 2003; Salvatore, 2005) and the hassles in beating the naive random walk hypothesis in forecasting spot rates (Taylor, 1995; Obstfeld and Rogoff, 2000; Cheung, Chinn and Pascual, 2005). Likewise, certain "volatility" puzzles relate to the inexplicable behaviour of the second moments of the exchange rate. Very similar problems with the economic models arise when stock prices are under consideration (Shleifer and Summers, 1990). Keywords

such as irrational exuberance, irrational bubbles, noise trading and so forth all describe but one thing: the impossibility to match theoretical models with the data.

So far, the bulk of criticism of the rational expectations paradigm and hence the suggestions for overcoming its empirical problems has addressed the assumption of rational behaviour of individuals. In his survey of the literature on bounded rationality, Conlisk (1996) already lists four major reasons as to why individuals can hardly be expected to shoulder the task of really fully exploiting all available information. He quotes not only the many economic papers that demonstrate the failures of the rationality hypothesis but also discusses some contributions to the psychology literature. Similarly, Tirole (2002) puts forth four reasons as to why we may observe deviations from rational behaviour. Other contributions extend this list towards learning and sentiments (see, e.g., Grauwe and Kaltwasser, 2007; Bacchetta and van Wincoop, 2005; Sims, 2005).

Another common strategy to bridge evidence and theory is to amend empirical methods, data frequency, geographical data origin and sample periods. An editor of a renowned journal has neatly summarised these amendments with reference to the uncovered interest parity literature as follows (emphasize added):[27]

> [...] Lothian [...] recently wrote a paper that tried to find the best evidence for UIP and using 100 to 200 years of bond data for about 20 rich countries, he found good but still noisy evidence that UIP held. [...] Lothian notes that 2/3 of the beta coefficients (which should equal exactly 1 in theory) have values of between 0.75 and 1.25. But since we can still "fail to reject" the hypothesis that beta equals 1, Lothian treats this as *pro-UIP long run evidence*. He still notes however, that things may be more complicated in the short run [...]
>
> I think Lothian's approach is the right one, and [...] most readers would come to Lothian's conclusion: That it's nice that "in the extremely long run" UIP holds on average, but it's still a puzzle why it often fails to hold in the short run.

The epistemological stance of this kind of reasoning is not only truly remarkable but also rather commonplace in contemporary economics. The key support for UIP is derived from sufficiently generous confidence intervals ("2/3 of the beta coefficients [...] have values of between 0.75 and 1.25") that do not permit rejection of the central hypothesis and, in case the central hypothesis is rejected, this rejection is explained away as a phenomenon owed to sample length, for example. These rejections are not even questioned as being erroneous; quite to the contrary, they live alongside the central hypothesis and their presence plays the role of an inexhaustible source of future publications that are meant to "reconcile" the contradictory findings.

It should be recalled that the positivist epistemology would have it that a single (undisputed) rejection of the central hypothesis would suffice to reject the theory. This is exactly why Newton's mechanics eventually replaced Descarte's theory[28] of "corpuscles" and Newton's mechanics had to give way (on the cosmic scale)

to Einstein's relativity principle. The same will eventually happen to the current macroeconomic paradigm, though there is still a long way to go.

In order to understand why it is so difficult to let lose, two further, structural issues should certainly be considered. The first issue rests with the very construction of macroeconomic puzzles.[29] Remember that these puzzles arise because empirical data contradicts the theory based on rational expectations. But rational expectation is a composite concept that holds together the "corpuscles" of the paradigm, which means that rejecting the central hypothesis does not provide any hint as to what "corpuscle" has been rejected. Is it individual fallibility (Soros, 2013), utility maximisation, equilibrium, risk or the theory? Each of these elements can be speculated to lead to a rejection without ever being able to identify the true culprit.

This indeterminacy of the reasons for rejection constitutes the source for infinite publications that was mentioned before. Its main epistemological relevance is to immunise the theory against definite falsification. Hence, this immunisation is the deeper reason why empirical rejection does not result in the accumulation of puzzles which would otherwise force a shift in the paradigm. Quite to the contrary, instead of triggering a paradigmatic change, the indeterminacy provides the justification for the theory to coexist with its own refutation.

The second issue relates to the alternative to the current paradigm. In other words, even if one was ready to abandon the current paradigm, what concept should be used instead?[30] One possible candidate for a substitute of the current paradigm could be the introduction of uncertainty.

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