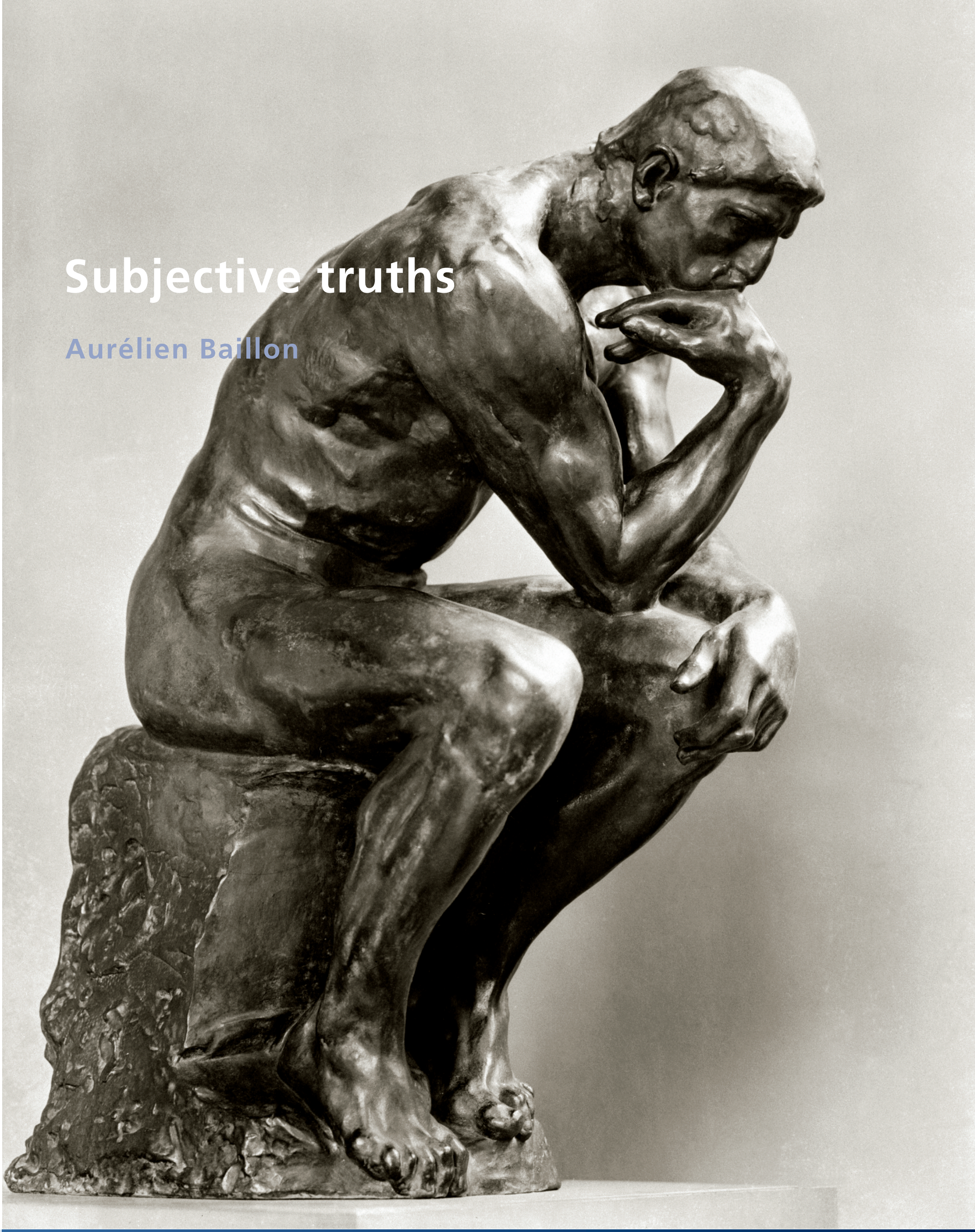
Subjective truths

Aurélien Baillon



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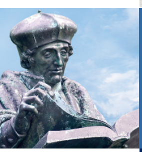

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Address delivered at the occasion of accepting the appointment of
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Samenvatting

Aan de ene kant zijn economen sterk afhankelijk van harde cijfers: het BBP, groeicijfers, wisselkoersen. Aan de andere kant, baseren zij hun uitleg vaak op zachte factoren: het vertrouwen van managers in de economie, de stemming van de consument en de beleggersverwachtingen. De harde cijfers zijn objectief, maar de zachte factoren zijn subjectief en individu-afhankelijk. Economen erkennen steeds meer de behoefte om subjectieve factoren te bestuderen. Het eerste deel van de oratie gaat in op de sleutelrol van subjectieve waarheden in de moderne economie. Zo wordt voorgesteld om het BBP te vervangen door de subjectieve mate van welzijn, of op zijn minst hiermee te complementeren; economisch beleid wordt vaak gebaseerd op subjectieve prognoses door deskundigen.

Het tweede deel van de lezing zal aantonen dat zelfs de zachte factoren, ook al zijn ze subjectief, objectief kunnen worden bestudeerd. In het bijzonder zullen we zien hoe je mensen kan stimuleren hun verwachtingen maar ook hun vertrouwen over toekomstige gebeurtenissen te onthullen. Tenslotte zal ik laten zien hoe je mensen waarheden kan laten onthullen die volledig oncontroleerbaar zijn.

Abstract

On the one hand, economists heavily rely on hard numbers: GDP, growth rate, and exchange rates. On the other hand, their explanations often rely on soft factors: executive confidence in the economy, consumer sentiment, and investor expectations. The hard numbers are objective, but the soft factors are subjective and depend on each individual. Economists increasingly recognize the need to study subjective factors. The first part of the lecture illustrates the key role of subjective truths in modern economics. For instance, measures of subjective well-being are now being proposed to replace or at least complement GDP. Economic policies often rely on subjective forecasting by experts.

The second part of the lecture will show that even though they are subjective, the soft factors can still be studied objectively. We will see how to incentivize people to reveal their expectations about future events but also their confidence in their expectations. Finally, I will show how to make people reveal truths that are completely unverifiable.

Content

1. Introduction

Dear Rector Magnificus,
Dear Dean of the Erasmus School of Economics,
Dear colleagues, students, friends, and family,
Dear distinguished guests,

Economists sometimes seem to be schizophrenic. On the one hand, they love hard numbers: GDP, growth rates, and exchange rates. On the other hand, their explanations often rely on soft factors: executive confidence in the economy, consumer sentiment, and investor expectations.

The hard numbers are objective: independent of the observer, and agreed upon. The soft factors are subjective: "influenced by personal feelings, tastes, and opinions"; they are "dependent on the mind for existence" (Oxford Dictionary). For instance, the statement "I feel good" is subjective.

Behavioural economist George Loewenstein recently said: "Our perception of, and reaction to, reality is subjective. How you *feel* about products, or even about your life, is at least as important, and probably much more important, than the product or your life's objective characteristics." Economists increasingly recognize the need to study subjective factors. And even though they are *subjective*, we can still *objectively* measure and study them. In the present lecture, I will illustrate the need to study subjective truths, and explain methods to do so. These methods are based on the typical economist's toolbox, such that we will no longer be "schizophrenic".

As economists, we study people's choices – their decisions. Our theories tell us how to interpret the choices. I will describe methods based on people making decisions and being rewarded when they decide to tell the truth. Respondents may bear a cognitive cost to find or report the right answer. Rewarding truth-telling compensates those who provide efforts and bear this cost.

The first part of the lecture illustrates the key role of subjective truths in modern economics. The second part focuses on how to incentivise people for revealing their expectations about future events. The third and last part describes the challenge of measuring unverifiable truths: the truths that are completely subjective and not even linked to any verifiable events.

2. Subjective truths in economics

2.1. New welfare measurements

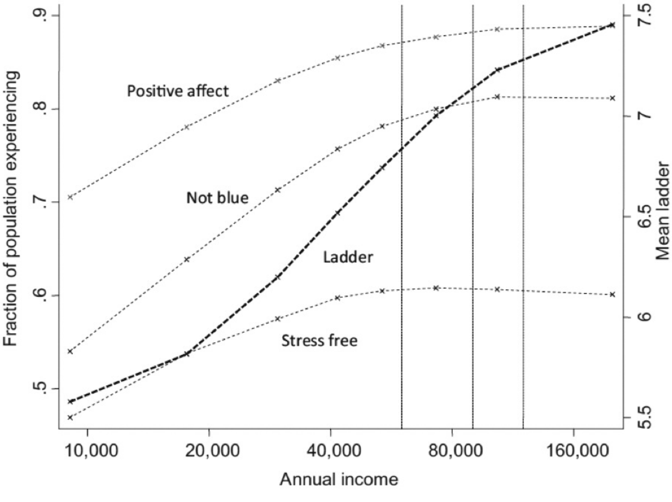
Following the work of Easterlin in the 1970s, a large and dynamic field measures how happy people are with their life. Welfare has long been restricted to measures of wealth or income. Nobel Prize winners Kahneman, Sen, and Stiglitz have argued in favour of measuring people's subjective well-being to replace or at least complement GDP (Kahneman et al. 2004 and Stiglitz et al. 2009).

Kahneman and Deaton (2010) showed that global life satisfaction (bold line "ladder" in Figure 1) increases with income, but that emotional well-being (measured by questions about recent emotional experiences) does not increase beyond an annual income of $75,000. For low incomes, a higher annual income decreases the tendency to feel blue and stressed, and increases the tendency to be in a positive affect (reporting happiness, smiling, and enjoyment). But it does not have any clear positive effect beyond $75,000. These results illustrate how measures of subjective well-being may lead to different conclusions than measures of material well-being.

In 2009, in France, the Stiglitz-Sen-Fitoussi commission proposed new guidelines to measure social progress, and recommended a shift from economic production to well-being. Recognising the importance of life satisfaction, the OECD has recently published guidelines to obtain reliable and consistent measures. At this university, the Erasmus Happiness Economics Research Organisation (EHERO) is dedicated to economics research on happiness.

If GDP is to be replaced by subjective measures of welfare, we need to ensure the quality of these measures. A challenge is that no-one can verify whether someone who claims to be happy actually is happy. In the last part of the talk, I will come back to this challenge.

Figure 1: "Positive affect, blue affect, stress, and life evaluation in relation to household income. Positive affect is the average of the fractions of the population reporting happiness, smiling, and enjoyment. "Not blue" is 1 minus the average of the fractions of the population reporting worry and sadness. "Stress free" is the fraction of the population who did not report stress for the previous day. These three hedonic measures are marked on the left-hand scale. The ladder is the average reported number on a scale of 0–10, marked on the right-hand scale." *From Kahneman and Deaton (2010)*



2.2. Beyond rational expectations

A second example of the use of subjective truths in economics is related to expectations. Let me start with a brief story. In developing countries, the absence of health insurance can expose households to health care expenditures that may exceed their resources. It may thus force them to sacrifice assets or to increase debts. The lack of health insurance can therefore be a serious obstacle on the development path. To overcome this obstacle, many initiatives have been taken to propose affordable health insurance.

Potential demand for health insurance has been shown to be sufficient for a sustainable insurance market (Pauly et al. 2009). Yet, attempts to provide health insurance have resulted in enrolment rates of between 1% and 10% (De Allegri et al. 2009), far below what was predicted. How could the predictions be so wrong?

To estimate potential demand for insurance, economists relied on objective data on risk prevalence. The *rational expectations paradigm*, central in economics, assumes that economic agents use all available information to derive objectively correct beliefs about the risks they face. This paradigm leads economists to equate agents' beliefs with the objective statistical information about the risks. But there are many reasons why agents' actual beliefs may differ from this statistical information.

Starting with Tversky and Kahneman (1974), psychological research has shown that beliefs can be miscalibrated, which leads to overconfidence or overoptimism, and hence, irrational expectations. In the 1980s, researchers showed how people tended to be unrealistically optimistic about the risks they faced. For instance, in a study about perceptions of health-related risks, Weinstein (1987) asked participants to compare the likelihood of experiencing some given health problems compared to others of the same gender and age. They responded on a –3 (much less likely to face the problem) to a +3 (much more likely to face the problem) response scale. On average, it should be 0, but the average was always negative. People thought they were less likely to face addiction problems, to have a nervous breakdown, or to get lung cancer than others, therefore exhibiting unrealistic optimism.

Not only may people have biased beliefs, they may also have different degrees of confidence in their beliefs. In 1921, in "A Treatise on Probability", John Maynard Keynes pointed out that the amount of evidence a person has to support his beliefs might be as crucial as the beliefs themselves. Hence, we should not only consider what people believe, but also how much they trust what they believe, to fully understand and predict people's behaviour.

Possibly biased beliefs and different degrees of confidence in beliefs constitute the two main deviations from rational expectations. But if these factors are irrational, should economists still take them into account? John Neville Keynes, father of John Maynard, distinguished normative economics (studying *what ought to be*), from positive economics (studying *what is*) and applied economics, which he also called "the art of economics", and which establishes precepts to improve *what is*. Rational expectations can help to define what ought to be, but in positive or applied economics, we need to observe what people actually expect. We need to measure their subjective expectations. This is, for instance, what I am doing with my health economist colleagues Owen O'Donnell, Ellen van de Poel and Kim van Wilgenburg. We are currently working on a survey to measure expectations about medical expenditures in the Philippines.

2.3. Holding experts accountable

In many cases, risks cannot be objectively quantifiable, and governmental policies have to rely on subjective risk estimates. For example, Sims (2002) studied the decision processes of four central banks: the Swedish Riksbank, the European Central Bank, the Bank of England, and the U.S. Federal Reserve. He found that *"in each of the four central banks, 'subjective' forecasting, based on data analysis by sectorial 'experts,' plays an important role."*

To estimate the risks related to global warming, we cannot rely on frequencies derived from past observations. Climate experts develop models which incorporate all the information they have about the impact of human activities and their future development. But they also have to choose which models, which parameters, and which scenarios are more likely (Schneider 2002).

The first part of this lecture consisted of three examples of the role of subjective truths in modern economics. If subjective truths are playing such an increasing role, we should make sure that they are correctly measured. For instance, if economic policies are based on subjective estimates of experts, then we have to make sure that these experts tell the truth and are held accountable for their claim. The second part of the lecture will describe methods to do so, starting with a method initially developed to hold weather forecasters accountable for forecast accuracy.

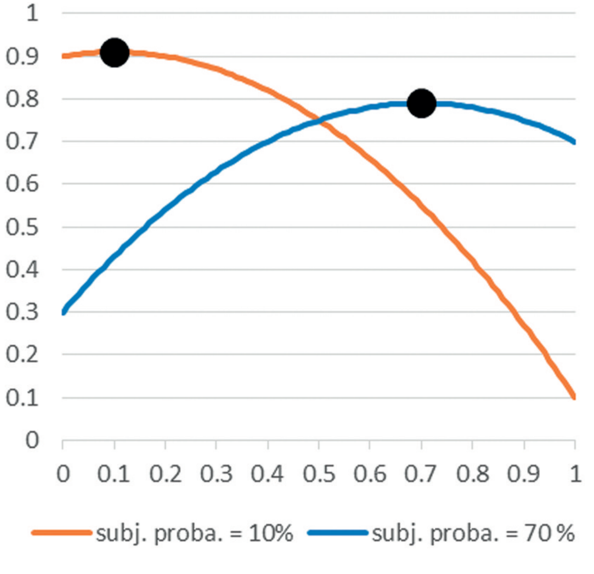
3. Measuring subjective expectations

3.1. Scoring rules and prediction markets

In the first half of the 20th century, weather forecasting developed quickly, but also led to a new question: how can we know whether the forecast is right? If forecasters say it might rain with a probability of 20% and it actually rains, the forecast is not completely wrong. So how can we reward them?

In 1950, Glenn W. Brier, a researcher at the US Weather Bureau, proposed the use of a *scoring rule*. Forecasters report their subjective probability and receive a score that depends on the assessed probability and on the event occurring (or not). The Brier score is computed such that forecasters who maximise their expected scores have incentives to tell the truth – their subjective truth. This can be used to reward the experts, identify the best ones, but also to teach them how to become better experts by providing feedback.

Figure 2: Expected scores given by the quadratic scoring rules for different subjective probabilities. The orange line represents the expected score if the forecaster's subjective probability is 10%, the blue line represents the expected score if the forecaster's subjective probability is 70%.



The most famous scoring rule is the quadratic scoring rule. Formally, if the forecaster reports that the probability of rain is r, he receives $1-1-r2$ if it rains and $1-r2$ if it does not rain. Figure 2 displays the expected score as a function of r. The orange curve is the expected score if the forecaster believes it will rain with a probability of 10%, and the blue curve is the expected score if he believes the probability is 70%. The graphs shows that the maximum score is reached if the forecaster reports his true belief.

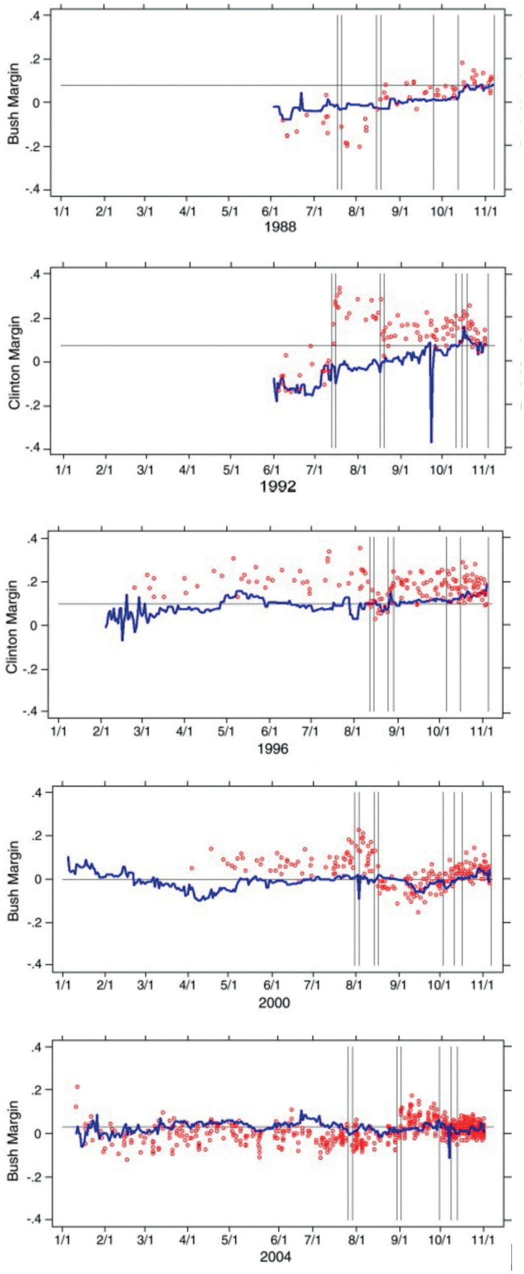
Another approach to measure expectations is to study people's willingness to bet on an event. Consider a bet that pays €1 if it rains and nothing otherwise. A person maximising her expected gains and whose certainty equivalent for this bet is €0.40 reveals that her subjective probability for the event "it rains" is 40%. This mechanism is used in prediction markets.

Prediction markets allow participants to stake bets on the likelihood of an event taking place. The price reflects the 'market probability' of the event, a sort of aggregate of traders' opinions. Prediction markets *"have been used by decision-makers in the U.S. Department of Defense, the health care industry, and by multibillion-dollar corporations such as Eli Lilly, General Electric, Google, France Telecom, Hewlett-Packard, IBM, Intel, Microsoft, Siemens, and Yahoo"* (Arrow et al. 2008).

Predictions markets have been shown to outperform polls in predicting election results (Berg et al. 2008). Figure 3 compares the outcome predicted by polls (represented by red circles) to that predicted by prediction markets (represented by blue lines). The horizontal grey line depicts the election results. Overall, prediction markets were closer to the election results about 75% of the time.

Prediction markets are based on the assumption that people's willingness to bet reveals their subjective probability. However, as mentioned earlier, Keynes suggested that the amount of evidence people have to support their beliefs also matters. We will now see how ignoring this aspect may lead to contradictions, and how to solve these contradictions.

Figure 3: "Implied vote-share margins for the market and polls. The vertical axis is the vote margin; the horizontal axis is the date; the margin implied by the market is the solid moving line; poll margins are represented by small circles; the horizontal lines indicate the election outcome, the vertical lines are the beginnings and ends of conventions, debate days and election days." *From Berg et al. (2008)*



3.2. The source method

In 1961, Ellsberg was the first to clearly establish the contradictions. Imagine that there are two urns. The first one, called the "known urn", has 50 red and 50 black balls. The second one, called the "unknown urn", has 100 balls, red or black, but in unknown proportion. Imagine you can win €100 if you draw a red ball; which urn would you prefer to draw from? Imagine now that you can win €100 if you draw a black ball; which urn would you prefer to draw from? Most people prefer to draw from the known urn (with 50 red and 50 black balls) in both cases, acting as if the chance of drawing a red ball from the unknown urn is less than 50%, but also as if the chance of drawing a black ball from the same unknown urn is less than 50%. It implies that they act as if their subjective probabilities do not add up to 100%, which contradicts the mere notion of probability. This is called the Ellsberg paradox. People dislike betting on unknown processes. This phenomenon is called *ambiguity aversion*.

Consider only the second, unknown urn. A ball will be drawn from it. Would you prefer to win €100 if the ball is red or if the ball is black? Most people would be indifferent, meaning that red and black are equally likely. If two complementary events are equally likely, their probability must be 50%. To summarise, people act as if the probability of red and the probability of black are both 50% if they only bet on the unknown urn, but not if they can also bet on the known urn.

The conclusion is that you can still behave as if you have well-defined subjective probability if you bet only on one type of uncertainty – one source of uncertainty – but contradictions may arise when you compare two sources of uncertainty. This concept of source of uncertainty was introduced and extensively studied by Amos Tversky and his co-authors in the 1990s. As suggested by Keynes, two events with the same probability, but with different amount of evidence supporting the probabilities may not lead to the same behaviour. Differences in behaviour reveals people's confidence in their beliefs.

Together with Mohammed Abdellaoui, Laetitia Placido, and Peter Wakker, I developed the source method. We first studied choices related to a unique source of uncertainty to derive people's subjective probabilities (represented on the x-axis of Figure 4), and we then obtained their willingness to bet (y-axis). The willingness to bet, initially expressed in euros, was corrected to take into account that everyone has his or her own subjective evaluation of money (what economists call utility).

The willingness to bet obtained for subjective probabilities can then be compared with the willingness to bet obtained with objective probability. The Ellsberg example described above predicts that the willingness to bet on objective probabilities is higher than the willingness to bet on subjective probabilities.

Moreover, together with Daniel Kahneman, Amos Tversky put forward another phenomenon, called likelihood insensitivity. The difference between 0% and 1% chance to win is substantial: in the former case you cannot win, in the latter, you may. By contrast, the difference between 56% and 57% does not seem big. This phenomenon explains the inverse-S shape of the willingness to bet curve on objective probabilities: the curve may be quite flat around 50%. Now imagine that you are not even sure whether these 56% and 57% probabilities are accurate. It is then quite plausible that you will treat them as equivalent. The difference seems even smaller, and the willingness to bet curve would be even flatter. The less people know, the more they treat everything as 50-50. The extreme case would be a horizontal line.

In an experiment using traditional Ellsberg urns, we indeed observed that the willingness to bet curve for the unknown urn tended to be lower and showed more likelihood insensitivity than the curve for the known urn. In another experiment conducted in Paris, the same type of pattern appeared when we compared willingness to bet on objective probabilities with willingness to bet on the temperature one month later. Participants disliked betting on temperature in a foreign country even more, as shown by the red dashed curve in Figure 5.

To summarise this part, interpreting willingness to bet as subjective probabilities can lead to contradictions. However, with the right theory, the contradictions disappear and other aspects of people's behaviour such as their liking or disliking of a source of uncertainty, but also their likelihood insensitivity can be measured.

Figure 4: Willingness to bet on Ellsberg's urn measured in utility units. *From Abdellaoui et al. (2011)*

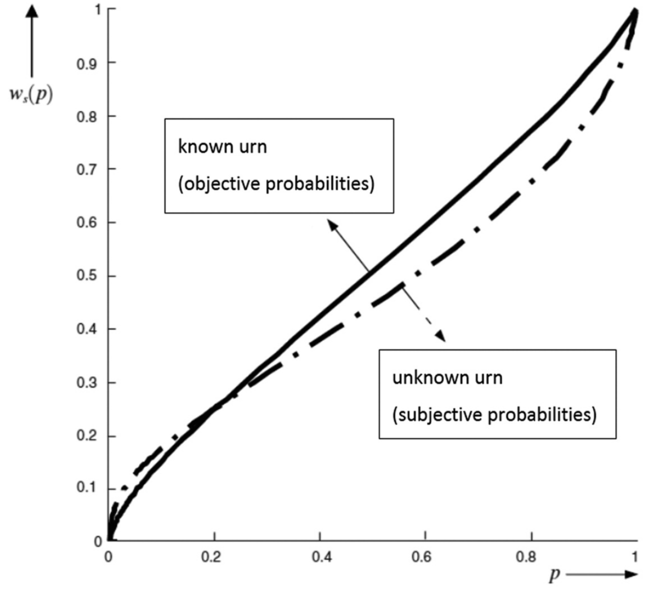
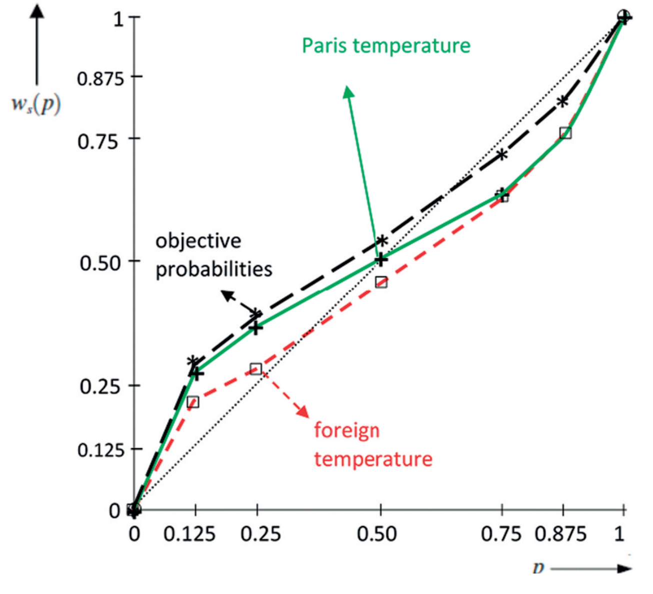


Figure 5: Willingness to bet on natural events measured in utility units. *From Abdellaoui et al. (2011)*



4. Measuring unverifiable truths

4.1. The challenge

Scoring rules and prediction markets can be used to collect a judgment or an opinion related to an observable event. They indeed require that either the event on which the bet is defined or its complement actually occurs in order to determine the score or who wins the bet. In a prediction market for elections, the election winner is known in the end, and the bookmakers pay out the agreed-upon amount to the bettors.

But these methods cannot be applied to beliefs about unverifiable events. A British astronomer once wrote that the odds of human civilisation surviving beyond 2100 were no more than 50%. A prediction market for such an event is not feasible, because if there is no human survival, punters will no longer be alive to reap their rewards. Less dramatic events may also cause difficulties to implement scoring rules and prediction markets. A scoring rule to reward experts on global warming would only reward the good experts in 50 years or more, when the actual consequences of global warming are known. Hence, it would be too late, and anyhow, most of the current experts would probably not be alive. Many theories about global warming are unverifiable in the short run, but decisions have to be taken now.

Other subjective truths we may want to measure, such as happiness or well-being, are also not easily verifiable. Only you really know how you feel. So how can we incentivise truthfulness if we cannot verify what the truth is? Another example concerns health studies and asking people to report their behaviour. Such health studies sometimes deal with unobservable taboo behaviour. Other examples of unverifiable truths are hidden unethical practices or illegal activities.

In all of these examples, we would like to be sure to obtain truthful answers: answers which are honest and carefully considered. Yet, telling the truth about some taboo behaviour entails a psychological cost. Similarly, an expert carefully considering an answer bears a cognitive cost. Rewarding people for telling the truth is a way to compensate people for this cost in order to obtain more truthful answers.

4.2. The solution(s)

It has long been thought that rewarding truth-telling for such unverifiable truths was simply impossible. In 2004, Dražen Prelec, an MIT professor who is also a visiting professor at our school, proposed a first solution, which he called a Bayesian truth serum. It is based on a key intuition, well-known, in psychology. What you think others would do, think, or feel is influenced by what you yourselves would do, think, or feel in a similar situation. In 1977, Ross, Greene, and House found that students who said they were shy expected 46% of other students to say the same. However, non-shy students expected only 36% of students to answer they were shy. Students reporting difficulties to control their temper expected that the same would be reported by 42% of students. Yet, students who said they had no difficulty to control their temper expected only 28% to say they had difficulty. The same pattern appeared for opinions about the use of nuclear warfare or the discovery of extra-terrestrial life. People who agreed with a statement expected more people to agree than those disagreeing with the statement had expected. At the end of the 1970s and in the 1980s, this pattern was thought to be irrational. It was called the false consensus bias. In 1989, Dawes showed that this pattern can actually be perfectly rational. Using pure Bayesian logics, he showed that your own answer is a signal that is informative about the population and that two opposite answers will naturally move your expectation about the rest of the population in two opposite directions.

Prelec used this reasoning to design a new type of scoring rule, which he called a Bayesian truth serum. You are asked to answer a question and predict what the others will answer. You are rewarded if your prediction is correct and you get a bonus if your answer is more common than what others predict on average. Bayesian reasoning tells us that your own truth is more common than that predicted by others, and therefore, you should tell the truth. In other words, Prelec proposed a way to adapt scoring rules to unverifiable truths. But could we adapt prediction markets as well?

We know that a prediction market for the survival of humans beyond 2100 cannot work. But we could have a market in which people trade an asset whose value will be the proportion of people agreeing with the pessimistic statement of the British astronomer. Those who agree with the astronomer will expect a higher asset value than those who disagree. The challenge that I plan to tackle in the coming years is to design and implement such a market, which will reveal people's subjective truths, even if these truths are unverifiable.

5. Conclusion

I hope I have convinced you that subjective truths, from people's well-being and expectations to experts' predictions, play an increasing role in economics.

To measure people's expectations, we need the right theories to rule out contradictions and to be able to interpret what we observe. I presented the source method, which interprets the willingness to bet with modern theories. The source method allows us to disentangle subjective probabilities from psychological phenomena such as likelihood insensitivity.

Finally, rewarding truth-telling when the truth is unverifiable is still a major challenge. Developing a practical solution is one of my main research goals for the coming years. Such a solution would complete the set of methods we, as economists, have to objectively study subjective truths.

6. Words of thanks

How thankful I am is a subjective truth. Hence, it provides a good opportunity to test what you remember of this lecture.

Question 1:

What can you infer from the following statement? "I think the proportion of people who are grateful to Peter Wakker and Han Bleichrodt is even higher than what people, on average, think."

From this statement and the results of Ross, Greene and House (1977), you can infer my subjective truth. Thank you, Han and Peter for giving me the chance to work with you.

Question 2:

What did John Neville Keynes call the "art of economics"?

As in every test, there is an easy question… The answer is "applied economics". I would like to thank my colleagues at the Department of Applied Economics, faculty and staff, for the great work environment and the friendly atmosphere. I am grateful to the successive department directors, Justus Veenman and Enrico Pennings, for giving me the possibility to develop within the department. Thank you, Kirsten, for your friendship but also for knowing how to plan and how to carry out plans.

Question 3:

Over the last 8 years, my gross salary has constantly increased. How do you think my life satisfaction has evolved?

According to Kahneman and Deaton (2010), life satisfaction is positively correlated with income. However, it may not be a causal relationship. Although an increasing income surely played a role in my material well-being, the interaction with our PhD students definitely had a strong positive impact on my professional life satisfaction. I would like to thank our past and current PhD students for their enthusiasm. I am also grateful to the Dean of the Erasmus School of Economics, and to the directors of our research institutes (the Tinbergen Institute and ERIM) for giving us the possibility to conduct research and to teach research.

Question 4:

Consider three bets yielding €10 if it rains on a given day in Ambierle (FR), in Paris (FR), and in The Hague (NL) respectively. My willingness to bet is the highest for "rain in The Hague" and the smallest for "rain in Ambierle". What can you infer?

Hint: I lived in each of the three places for at least 6 years.

As in every test, there is a trick question... Willingness to bet can reveal beliefs, but not if the events belong to different sources of uncertainty. Two events with the same probability, but with a different amount of evidence supporting the probabilities may lead to different behaviour. But as I have lived in all three places, I have considerable evidence for all. Hence, the willingness to bet does reveal my beliefs.

I feel at home in Ambierle, in Paris, and in The Hague, because my friends and my family are there. Thank you all for being here today, and thank you to my friends, my family, and Oliver for being there for me.

7. References

Abdellaoui, M., A. Baillon, L. Placido, & P. P. Wakker (2011), "The Rich Domain of Uncertainty: Source Functions and Their Experimental Implementation," *American Economic Review* 101(2):699-727.

Arrow, K. J., R. Forsythe, M. Gorham, R. Hahn, R. Hanson, J. O. Ledyard, S. Levmore, R. Litan, P. Milgrom, F. D. Nelson, G. R. Neumann, M. Ottaviani, T. C. Schelling, R. J. Shiller, V. L. Smith, E. Snowberg, C. R. Sunstein, P. C. Tetlock, P. E. Tetlock, H. R. Varian, J. Wolfers, & E. Zitzewitz, (2008) "The Promise of Prediction Markets," *Science* 320:877-878

Berg, J.E., F. D. Nelson, & T. A. Rietz (2008) "Prediction market accuracy in the long run," *International Journal of Forecasting* 24(2):285-300

Brier, G. W. (1950) "Verification of Forecasts Expressed in Terms of Probability," *Monthly Weather Review* 78:1–3.

Dawes, R. M. (1989) "Statistical criteria for establishing a truly false consensus effect," *Journal of Experimental Social Psychology* 25(1):1-17.

De Allegri, M., R. Sauerborn, B. Kouyate, & S. Flessa (2009) "Community health insurance in sub-Saharan Africa: what operational difficulties hamper its successful development?" *Tropical Medicine & International Health* 14(5):586-596.

Easterlin, R. A. (1974). "Does economic growth improve the human lot? Some empirical evidence." In Paul A. David and Melvin W. Reder, eds., *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*, New York: Academic Press.

Kahneman, D., & A. Deaton. (2010) "High income improves evaluation of life but not emotional well-being," *Proceedings of the National Academy of Sciences* 107(38):16489-16493.

Kahneman, D., A. B. Krueger, D. Schkade, N. Schwarz, & A. Stone (2004) "Toward national well-being accounts," *American Economic Review* 94(2):429-434.

Keynes, J. M. (1921) *A Treatise on Probability.* Macmillan, London. 2nd ed. 1948.

Pauly, M. V., F. E. Blavin, & S. Meghan (2009) "How private, voluntary health insurance can work in developing countries," *Health Affairs* 28(6):1778-87.

Prelec, D. (2004) "A Bayesian Truth Serum for Subjective Data," *Science* 306:462-466.

Ross, L., D. Greene, & P. House (1977) "The 'false consensus effect': An egocentric bias in social perception and attribution processes." *Journal of Experimental Social Psychology* 13(3):279-301.

Schneider, S. H. (2002) "Can we estimate the likelihood of climatic changes at 2100?" *Climatic Change* 52(4):441-451.

Sims, C. A. (2002) "The Role of Models and Probabilities in the Monetary Policy Process," *Brookings Papers on Economic Activity* 2:1-62

Stiglitz, J., A. Sen, & J-P. Fitoussi (2009) "The Measurement of Economic Performance and Social Progress Revisited - Reflections and Overview"
http://www.stiglitz-sen-fitoussi.fr/en/documents.htm

Tversky, A. & D. Kahneman (1974) "Judgment under Uncertainty: Heuristics and Biases," *Science* 185:1124–1131.

Tversky, A. & D. Kahneman (1992) "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty* 5:297–323.

Weinstein, N. D. (1987) "Unrealistic optimism about susceptibility to health problems: Conclusions from a community-wide sample." *Journal of Behavioral Medicine* 10(5):481-500.

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