Economic uncertainty principle?

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This preliminary paper presents a qualitative description of the economic principle of (hidden, latent) uncertainty. Mathematical expressions of principle, consequence, hypothesis and results are offered. Examples of solutions of the first three types of fundamental problems are reviewed.

Contents

Introduction

There are a considerable number of discussed aspects of uncertainty. There is a wealth of aspects of uncertainty to be discussed. This preliminary paper qualitatively examines one of them.

1. Economic uncertainty principle

1.1. General economic uncertainty principle

1.1.1. Preliminary definition

Future events may be considered as, at least partially, uncertain.

This uncertainty or partial uncertainty may be invisible, imperceptible. It may be crucial. In any case, the overwhelming majority of future events contain, at least a part of uncertainty. In a simple form this principle may sound like:

Future events contain (at least) a degree of uncertainty.

1.1.2. Evident and hidden (latent) uncertainties

There are evident and hidden, latent uncertainties. To consider evident uncertainties is, in a sense, obvious and trivial and often not helpful. The primary (but not the only) goal of the economic uncertainty principle is to consider hidden, latent uncertainties. So the new principle may sound like:

Future events contain (at least) a degree of (hidden) uncertainty.

It may also be (but not always) referred to as the principle of hidden (latent) uncertainties.

1.1.3. Influence of the principle

In some cases, an influence of this principle will be negligible. In some cases, this influence will improve a precision of calculations. In some cases, it will be essential, even crucial.

In any case, collective elaborate definition, development and application of economic uncertainty principle will improve the scientific accuracy of economic theory.

1.1.4. Example

Suppose Mr. Somebody offers you a prize. The choice is between a guaranteed prize or one of a lottery. The lottery prize has value, which is greater and the probability, which is less, than those of the guaranteed one. The mathematical expectations to win the lottery and guaranteed prizes are exactly equal to each other. The probability to win in the lottery is (certainly!) equal to P ($P < 100\%$).

This scenario gives rise to a number of unsolved fundamental problems (e.g., the Allais paradox, risk aversion, loss aversion, overweighting of low probabilities, the Kahneman-Tversky paradox, the equity premium puzzle).

So, instead of 50 years of numerous attempts at solving the famous paradox of Nobel laureate Allais, another Nobel laureate Kahneman, along with Thaler, (2005) noted "… the paradoxes of Allais (1953) … have demonstrated inconsistency in preferences."

The situation contains the evident uncertainty in the lottery (You may whether win or not). But there is a hidden uncertainty. It is, e.g., the probability to win in the lottery (and in reality receive your prize) may not be certainly equal to P (The lottery may have a defect or suffer a failure; suddenly, you or Mr. Somebody may become ill; Mr. Somebody's offer may be a joke or trick; anybody (curious person, terrorist, policeman, etc.) may interfere in the process, etc.).

Suppose three variants of the preliminarily determined probability $P_{preliminary}$. They are regarded as high, medium and low:

$$P_{high\ preliminary} = 99\%.$$
$$P_{medium\ preliminary} = 50\%,$$
$$P_{low\ preliminary} = 1\%,$$

Suppose the probability's uncertainty is $\pm\Delta P$. Then all variants of the real probability P will be uncertain

$$P \sim P_{preliminary} \pm \Delta P.$$

Suppose the probability's uncertainty is essentially more than 1% (e.g. $\Delta P = 10\%$) and is uniform. Then the mean real values of probability P_{mean}: will be

$$P_{high\ mean} < 99\%.$$
$$P_{low\ mean} > 1\%,$$

Real low probability will be higher than the preliminary one.
Real high probability will be lower than the preliminary one.
The unsolved problems may be solved.

1.1.5. Miscellaneous
Literature review

The search of the term "uncertainty principle" in economic literature found in titles or keywords offers no examples in the predominant meaning of this paper.

The classical review in Schoemaker (1982) and the most recent (one month before Harin 2005, the first feature paper on this idea) review in Quiggin and Chambers (2005) do not mention this idea. The author's review of RePEc from 1969 does not find this idea either.

Similar or supporting works are, e.g., Quiggin (2005), Capuano (2006), Hey (2005), Chay et al (2005), Novarese (2002).

Questions, generalization and analogies

At the present, the name and wording of the principle are open to questioning. Advices are welcomed.

Generally, this principle may be treated and referred to as "Future uncertainty principle" or "Principle of future's uncertainty" or "Principle of uncertain future" or "Principle of hidden uncertainties," etc.

The economic uncertainty principle may be, to some extent, treated in terms of incomplete or asymmetric information.

There are evident analogies between Heisenberg's uncertainty principle and Einstein's general and specific theories of relativity on one hand and the economic uncertainty principle on the other hand. There is an evident influence of the great physicians on the new principle.

Moreover, the economic uncertainty principle can be, to some extent, the consequence of Heisenberg's uncertainty principle. Indeed, one cannot simultaneously measure both impulse and position better than with uncertainty

$$\Delta p \times \Delta x \geq \hbar / 2$$

where

Δp - impulse uncertainty,

Δx - position uncertainty,

$\hbar$ - Planck's constant divided by 2π.

This fact, along with actual impossibility to know all reasons and origins of future events, can give rise to future events' uncertainties.

The situation, when comparing the economic theory without and with the economic uncertainty principle, is in a sense analogous to the situation when comparing classical and quantum physics. Classical physics does not consider Heisenberg's uncertainty principle which is one of the cornerstones of quantum physics. The "classical" economic theory does not consider the economic uncertainty principle.

Consider two processes:

a process which is a basic one for economics – a choice of an outcome which probability is P,

and

a process which is a basic one for physics – a scattering on a barrier which the height is H.

In the both cases, when the uncertainty is essential:

for high P and H the choice and the scattering are lower than those of the classical theory;

for low P and H the choice and the scattering are higher than those of the classical theory.

1.2. Specific economic uncertainty principle

1.2.1. Preliminary definition

The specific economic uncertainty principle emphasizes one of uncertain aspects of future events, namely probability. It states probabilities of future events are, to some extent, uncertain. This extent may be invisible, imperceptible. It may be considerable, even crucial. In any case, the overwhelming majority of future events contain, at least, a degree of uncertainty. In a simple form this principle may sound like:

The probability of a future event contains (at least) a degree of (hidden) uncertainty.

Or, more definitively:

The probability of every future event contains (at least) a degree of (hidden) uncertainty.

1.2.2. Mathematical expression of the definition

Mathematically, this principle may be written in the form of two expressions:

The first

(1.1a) $$P \sim P_{preliminary} + \Delta_{+}P(S_{Situation}; P_{preliminary}) - \Delta_{-}P(S_{Situation}; P_{preliminary})$$

where and below

P	- the value of real or future probability;
$P_{preliminary}$	- the preliminarily determined P;
$S_{Situation}$	- a set of parameters of the situation
$\Delta_{+}P$	- the part of probability's uncertainty, which increases P;
$\Delta_{-}P$	- the part of probability's uncertainty, which decreases P;

or, simplified,

(1.1) $$P \sim P_{preliminary} \pm \Delta P(S_{Situation}; P_{preliminary})$$

where

ΔP = (plus) $\Delta_{+}P$ and (minus) $\Delta_{-}P$

The second

(1.2) $$P_{mean} = P_{preliminary} + \delta P(S_{Situation}; P_{preliminary})$$

where

P_{mean}	- the mean value of P;
δP	- the shift, the bias of the mean value of real or future P in the comparison with the value of preliminarily determined P (δP may be as positive or negative).

1.2.3. First consequence

The aforementioned example

$$P_{high\ preliminary} = 99\%.$$
$$P_{medium\ preliminary} = 50\%,$$
$$P_{low\ preliminary} = 1\%,$$

and

$$P_{high\ mean} < 99\%.$$
$$P_{low\ mean} > 1\%,$$

using equation (1.2)

$$P_{mean} = P_{preliminary} + \delta P$$

may be generalized and written in the following forms:

(2.1a)
$$\delta P_{high} < 0$$
$$\delta P_{medium} \sim 0$$
$$\delta P_{low} > 0$$

where and below (in paragraph 1.2.3)

high - concerns to $P_{preliminary}$ (and corresponding P), such as (100% - $P_{preliminary}$) is small in comparison with $\Delta_+ P$

where and below

medium - refers to $P_{preliminary}$ (and corresponding P), which belongs to the medium of the range (0%; 100%) where $\delta P \sim 0$;

low - refers to $P_{preliminary}$ (and corresponding P), such as $P_{preliminary}$ is small in comparison with $\Delta_- P$

or

(2.1b)
$$P_{high\ mean} = P_{high\ preliminary} - |\delta P| < P_{high\ preliminary}.$$
$$P_{medium\ mean} \sim P_{medium\ preliminary}$$
$$P_{low\ mean} = P_{low\ preliminary}, + |\delta P| > P_{low\ preliminary},$$

or, simplified,

(2.1)
$$P_{high\ mean} < P_{high\ preliminary}.$$
$$P_{medium\ mean} \sim P_{medium\ preliminary}$$
$$P_{low\ mean} > P_{low\ preliminary},$$

1.2.4. First hypothesis

Compare these two events: a preliminarily uncertain event and a preliminarily certain event, e.g. lottery and guarantee. When the other conditions of these events are the same or similar to each other, the first hypothesis of the approach (or theory) of economic uncertainty states:

The shift of the probability of the preliminarily certain event is sufficiently less in comparison with that of the preliminarily uncertain (high probability) event.
(There is no need of such hypothesis for low probabilities)

More exactly (in terms of final mean values):
$\delta P_{certain}$ - the shift of the probability of the preliminarily certain event is as small (in comparison with δP_{high} - to that of the preliminarily uncertain (high probability) event) as to ensure the existence of a finitely small vicinity $v_{100\%}$ near P=100%, such as for the mean real values of probabilities $P_{high\ mean} = P_{preliminary} - |\delta P|$ and $P_{certain\ mean} = 100\% - |\delta P_{certain}|$

$$\frac{P_{high\ mean}}{P_{certain\ mean}} < \frac{P_{high\ preliminary}}{P_{certain\ preliminary}}$$

where and below
high - refers to $P_{preliminary}$ (and corresponding P), such as

$$100\% - v_{100\%} \le P_{high\ preliminary} < 100\% \quad (v_{100\%} > 0;\ v_{100\%} = const).$$

Usually, it should be sufficient to be true

$$|\delta P_{certain}| \le |\delta P((100\% - v_{100\%})_{preliminary})|$$

This hypothesis is intuitively obvious. Indeed, to be preliminarily certain, the event must have additional means to support this excess of certainty. However it is hard to be precisely and generally proved. Hopefully, it may be proven by collective efforts during next few years.

Though being not exactly and generally proved, this hypothesis helps, at least partially, to rationally explain a number of remaining unsolved problems (see below in 2. Problems solving).

1.2.5. Example

The first hypothesis allows to transform absolute values to normalized (relative) ones. From

$$\begin{aligned} &P_{high\ mean} && < P_{high\ preliminary}, \\ &P_{medium\ mean} && \sim P_{medium\ preliminary} \\ &P_{low\ mean} && > P_{low\ preliminary}, \end{aligned}$$

defining normalized values $P / P_{certain}$ as $P_{normalized}$, we obtain

$$\begin{aligned} &P_{high\ mean\ normalized} && < P_{high\ preliminary}, \\ &P_{medium\ mean\ normalized} && \sim P_{medium\ preliminary} \\ &P_{low\ mean\ normalized} && > P_{low\ preliminary}, \end{aligned} \tag{2.2}$$

And, defining $P_{mean\ normalized}$ as P, we may rewrite (2.2) in the simplified form as

$$\begin{aligned} &P_{high} && < P_{high\ preliminary}, \\ &P_{medium} && \sim P_{medium\ preliminary} \\ &P_{low} && > P_{low\ preliminary}, \end{aligned} \tag{2.3}$$

2. Problems solving

2.1. General

Economic uncertainty principle can explain, at least partially, a number of problems.

2.2. Allais paradox, risk aversion, overweighting of low probabilities …

First old fundamental problems, which can be explained, are the Allais paradox, the Ellsberg paradox, uniform explanation of both gains and losses, overweighting of low probabilities, risk aversion, loss aversion and the equity premium puzzle.

2.2.1. First type of results. High probabilities

Let us reconsider a part of the preceding example for probabilities which are close to 100%:
Suppose Mr. Somebody offers you a choice of only one of the following:

A guaranteed gain of \$99. Or
A lottery:
The gain of [1]\$100 with the probability $P_{(preliminary)} = 99\%$ or
\$0 with the (preliminary) probability 1%.

The mathematical expectations of guarantee $M_{guarant}$ and lottery M_{lott} outcomes are exactly the same:

$$M_{guarant} = \$99 \times 100\% = \$99, \quad M_{lott} = \$100 \times 99\% = \$99, \quad \text{so, } \$99 = \$99.$$

But the well-determined experimental fact is: in similar experiments the obvious majority of people chose the guaranteed gain instead of the lottery (see, e.g., Tversky and Wakker 1995). This is a modification of the aforementioned classical Allais paradox (see Allais 1953).

An explanation

"Anything-can-happen": the lottery may have defects or suffer a failure; Mr. Somebody or you may suffer a sudden deterioration of health; Mr. Somebody's offer may be a joke or trick; anybody (curious person, terrorist, policeman etc) may interfere in the process etc.

So, the real probabilities will be uncertain (independently of whether the preliminary ones are or not). For example, for, e.g., $\delta P = -12\%$ and $\delta P_{guarant} = -5\%$ and normalizing $P_{guarant}$ to 100%,

$$100\% - 5\% = 95\%, \qquad 99\% - 12\% = 87\%,$$
$$95\% : 95\% = 100\% \qquad 87\% : 95\% = 91.58\% \sim 92\%.$$

$$M_{guarant} = \$99 \times 100\% = \$99, \quad M_{lott} = \$100 \times 92\% < \$92, \quad \text{so, } \$99 \geq \$92.$$

So, really, the mathematical expectation of the guarantee outcome is more than that of the lottery outcome.

Therefore, the choice of the majority of people may correspond exactly to the mathematical expectations.

So, the specific economic uncertainty principle and its first hypothesis can naturally and clearly explain this and similar examples.

[1] For the experiment accuracy, both \$99 and \$100 should be in \$1 banknotes. So 99 and 100 banknotes of \$1.

2.2.2. Second type of results. Gains and losses
The complication of the Allais paradox

We may complicate the previous paradox and may compare these two experiments:

1) Mr. Somebody offers you a choice of only one of the following[2]:

A guaranteed gain of \$99. Or

A lottery:

The gain of \$100 with the probability 99% or

\$0 with the probability 1%.

2) Mr. Somebody offers you a choice of only one of the following:

A guaranteed loss of \$99. Or

A lottery:

The loss of \$100 with the probability 99% or

\$0 with the probability 1%.

The mathematical expectations of guarantee and lottery outcomes are exactly the same in both experiments. But in similar experiments, the obvious overwhelming majority of people chose (see, e.g., Di Mauro and Maffioletti 2004):

- in the case of gains - the guaranteed gain instead of the lottery one.
- in the case of losses - the lottery loss instead of the guaranteed one.

The possible well-known "natural and clear explanation" of gains in the Allais paradox by means of risk aversion cannot supply any uniform explanation for both gains and losses. The result of this explanation is gains' risk aversion and losses' risk seeking.

An explanation

The ideal preliminary equalities are:

for gains	$\$99 \times 100\% = \$99,$	$\$100 \times 99\% = \$99,$	so, $\$99 = \$99.$
for losses	$-\$99 \times 100\% = -\$99,$	$-\$100 \times 99\% = -\$99,$	so, $-\$99 = -\$99.$

For real biases, e.g. (see 2.2.1), $\delta P = -12\%$ and $\delta P_{guarant} = -5\%$ and normalized $P_{guarant\ mean} = 100\%$ and $P_{mean} = 92\%$ we have:

for gains:	$\$99 \times 100\% = \$99,$	$\$100 \times 92\% = \$92,$	so, $\$99 > \$92.$
for losses:	$-\$99 \times 100\% = -\$99,$	$-\$100 \times 92\% = -\$92,$	so, $-\$99 < -\$92.$

So, really:

the mathematical expectation of the guarantee gains' outcome is more than that of the lottery one.

the mathematical expectation of the lottery losses' outcome is more than that of the guarantee one.

Therefore, in the both experiments, the choice of the majority of people may be considered from the unified point of view and uniformly. This choice may correspond exactly to the mathematical expectations.

Therefore, the specific economic uncertainty principle and its first hypothesis can naturally and clearly explain this and similar examples as well.

[2] For the experiment accuracy, both \$99 and \$100 should be in \$1 banknotes. So 99 and 100 banknotes of \$1.

2.2.3. Third type of results. Low probabilities

Let us reconsider a part of the preceding example for probabilities which are close to 0%:

Suppose Mr. Somebody offers you a choice of only one of the following[3]:

A guaranteed gain of $1. Or

A lottery:

The gain of $100 with the probability $P_{lott} = 1\%$ or

$0 with the probability 99%.

The mathematical expectations of guarantee M_{guar} and lottery M_{lott} outcomes are exactly the same:

$M_{guar} = \$1 \times 100\% = \$1,\ M_{lott} = \$100 \times 1\% = \$1,$ so, $\$1 = \$1.$

But the well-determined experimental fact is: in similar experiments the obvious majority of people chose the lottery gain instead of the guaranteed one (see, e.g., Tversky and Wakker 1995). This fact is additionally not explained.

An explanation

Due to the specific economic uncertainty principle and its first hypothesis

$$P_{lott\ low\ mean} / P_{certain\ mean} > P_{lott\ low\ preliminary} / P_{certain\ preliminary} = 1\%.$$

For shifts from the preliminary to real values, which are equal to, e.g., $\delta P = 1\%$ and $\delta P_{guarant} = -2\%$ and normalized $P_{guarant\ normalized} = 100\%$ and $P_{mean\ normalized} = 2\%$ we have:

$M_{guarant} = \$1 \times 100\% = \$1,$ $M_{lott} = \$100 \times 2\% < \$2,$ so, $\$2 > \$1.$

So, really, the mathematical expectation of the lottery outcome is more than that of the guarantee outcome.

Therefore, the choice of the majority of people may correspond exactly to the mathematical expectations.

So, the specific economic uncertainty principle and its first hypothesis can also naturally and clearly explain this and similar examples.

2.3. Universality and uniformity of the approach of the principle

So, the economic uncertainty principle, particularly the specific economic uncertainty principle can, from the unified point of view and uniformly, explain more than one type of unsolved fundamental problems with the additional help of only one hypothesis.

(Hopefully, this hypothesis may be proven by collective efforts in the next few years)

[3] For the experiment accuracy, both $99 and $100 should be in $1 banknotes. So 99 and 100 banknotes of $1.

3. Arrangements' infringements

3.1. Plans and the need for this paper

The approach of arrangements' infringements was introduced in Harin (2005). However, instead of following explanatory papers, see, e.g., Harin (2006), this approach was not understudied by the scientific society. A possible reason may be the vague title of the approach. Probably, arrangements' infringements remain difficult to perceive.

A paper or an article about the economic uncertainty principle (as the generalization of arrangements' infringements) was planned for publication, at least, a year later. But, in comparison with the "arrangements' infringements," the "uncertainty principle" seems to be much more clear and easier to perceive. So, this (one-month-written) paper is written essentially earlier and quicker than it should be and, hence, it is a preliminary one.

3.2. Arrangements' infringements

The idea of arrangements' infringements is essentially the same as that of the economic uncertainty principle. Actually (and historically), the economic uncertainty principle is the generalization of the idea of arrangements' infringements. Arrangements' infringements are, in a sense, more particular and exact approach. The first and second hypotheses of the arrangements infringements approach (see Harin 2004) are somewhat similar to the specific economic uncertainty principle and its first hypothesis.

Below, the approach of arrangements' infringements is summarized.

3.2.1. Definitions

Arrangements will refer to arrangements, agreements, assumptions, regulations, bargains, contracts, plans, projects, etc.

Infringements will refer to infringements, breaches, modifications, disturbances, deviations, alterations, etc.

A condition will refer to a condition, term, circumstance, characteristic etc. Naturally, the term "condition" means the essential, material condition.

An arrangement infringement will refer to an infringement of at least one of the arrangement conditions that take place after the decision to fulfill this arrangement was made.

3.2.2. Hypotheses. First results. Applications.

The first hypothesis of the approach is:

When risky outcomes have probabilities, which are almost the same as the guarantee (100%), the arrangement infringement possibility can lessen real, objective probabilities and mathematical expectations of such risky outcomes in comparison with the guaranteed ones.

This hypothesis is obvious though challenging to prove. It is actually the result, even two types of results: explanations of problems of high probabilities and gains and losses.

Arrangements are the fundamental concept of economics and widespread economic events. They are the constituent elements of the majority of items in economic theory. Infringements of arrangements have similar significance. The variety of applications fields of idea's approach can be as important and as wide as that of arrangement infringements. In particular, these fields can be investment, banking, insurance, business projects estimation.

3.2.3. Analogies

Arrangements' infringements have rich analogs in other sciences:

Arrangements' infringements can be, in a sense, referred to as a "friction," "dissipation," "noise," "Brownian motion," etc in economics. (Problems of noise, noise traders, etc. are discussed in economics. See, e.g., Capuano 2006, Chay et al 2005 and Hey 2005.)

These analogs are of obvious original importance.

Moreover, often, friction, dissipation and noises hide or mask the action of an important law or laws. An example can be Galilean's insight regarding uniform motion. Such motion could not be observed in practice during Galilean times because of hidden action of friction.

Arrangements' infringements (even their possibilities) can hide the action of economic laws.

The accurate accounting of arrangements' infringements and their possibility can clear this action and these laws.

So, arrangements' infringements can be, to some extent, as fundamental, important and widespread in economics as their analogs in other sciences.

So, arrangements' infringements can be, to some extent, as fundamental, important and widespread in economics as economic laws, whose actions they hide.

These analogies and conclusions may be, at least partially, applied to the economic uncertainty principle also.

Conclusions

In a simplified form, the conclusions may be drawn as follows:
The general economic uncertainty principle:

Future events contain a degree of (hidden) uncertainty.

The specific economic uncertainty principle:

The probability of every future event contains a degree of (hidden) uncertainty.

Mathematically:

$$P \sim P_{preliminary} \pm \Delta P$$

$$P_{mean} = P_{preliminary} + \delta P$$

where and below

P	- real (future) probability;
$P_{preliminary}$	- the preliminarily determined value of P;
ΔP	- the uncertainty of the real (future) probability;
δP	- the shift of the real mean value of P in the comparison with the preliminarily determined value of P (δP may be as positive or negative).

The first application of the specific economic uncertainty principle:

$$\delta P_{high} < 0$$
$$\delta P_{low} > 0$$

or

$$P_{high} < P_{high\ preliminary}$$
$$P_{low} > P_{low\ preliminary}$$

where

high	- refers to probabilities, which values are about 100%
low	- refers to probabilities, which values are about 0%

These results can, at least partially, solve the Allais paradox, risk aversion, loss aversion, overweighting of low probabilities, the Ellsberg paradox, uniform explanation of both gains and losses, the equity premium puzzle and other unsolved problems.

Acknowledgement

The author wishes, as appropriate, to dedicate this preliminary paper and, mainly, a subsequent article to Maurice Allais, whose fundamental paradox first created an interest in the author to this sphere of research.

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