

## Economic Theory Needs a New View of the Phenomenon of Randomness

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### Abstract

This article was written as a contribution to the research project of the Faculty of Finance and Accounting at the University of Economics, Prague, Czech Republic, which was carried out within the framework of the institutional support of the University (IP 100040). Its authors deal with the question of the level of determinism in the world today and the role of randomness in the life of both society and individuals. The attempt to increase the formalisation and mathematization of economics has not proved to be effective. It has turned out that heuristicists and empiricists are better able to anticipate the consequences of randomness on economic conditions in the world and to explain the behaviour of people and economic subjects when solving decision-making problems in uncertain conditions. The dilemma of anticipating randomness in economic tasks is seen in the problem of the insurance business, the introduction of measures such as limits on the payment of damages and exceptions from the obligation to fulfill contracts, measures which certainly “sterilise” randomness and protect insurance companies from insolvency, but, at the same time, reduce the effectiveness of insurance.

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**Keywords:** randomness, decision under uncertainty, regulatory projects, insurance business, heuristic attitude

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### INTRODUCTION

In the wake of the recent momentous global financial, economic and, ultimately, debt crisis, there has been growing debate about the part played by scientific economic theory, including philosophy and general scientific methodology, in the current problematic global conditions, some of which have entirely different accompanying features from those of the past. Above all, there has been discussion about the need to seek new approaches to the paradigms of economic theory and the solution of the problems of economic policy and practice in general. The topic of this contribution is intended to contribute to that discussion.

One of the most pressing questions in philosophy, general scientific methodology and, by extension, economic science, is the extent of determinism in today's complex globalised world. Against that background, we may observe in contemporary economic theory two conflicting approaches, which originate from different methodological positions. The first, which today is definitely in decline, but which still has its strong supporters and which was at its peak in the 1990's, has been characterised by an attempt on the part of its advocates to shift the paradigms of economic science towards an analogy of the more deterministic paradigms of the “hard” scientific disciplines, with one clear aim: to enable, through a more rigorous approach (through maximalisation or optimisation) effective normative forecasting in economics too. This current of thought among theoreticians led by Prof. Samuelson introduced mathematical modelling techniques in

economics, although its supporters did not seriously consider the fact that that type of mathematics, non-dialectic methods of understanding, is too limiting for the problem in question, because it is clearly not possible to view the economic world in such a deterministic and non-dialectic way. Moreover, this approach ignores the ethical dimension of economic interactions, including their legislative framework<sup>1</sup>. As T. Sedláček points out /2009/, in an economy which demands a high standard of ethical behavior from the participants in economic interactions, the natural laws of the market are implemented better, whereas in a “predatory” economy, a higher level of regulation is essential.

Within that mindset, based on the illusion that that which has been mathematized and works in equations can be squeezed into a theory about homo

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<sup>1</sup>P. Robješek, the philosopher, economist and political scientist referred /2012/ to the failure of not only the political and power elites, but also of the scientific elites and their share of the responsibility for the current economic problems. He went on to say that the failure to master the complexity of the current global conditions is the most serious problem today. Among the causes of this situation, he believes, is the fact that economics has been overruled by politics, the belief that mathematics and other exact sciences are superior to other disciplines, that human technocracy is merely a romantic illusion, that what is mathematized and works in equations comes up against the limits of human ability, and that technological progress is limited by the possibilities of its users. The IT elite and other inventors no longer have a large enough public able to make use of increasingly subtle progress. P. Robješek expects a greater shift in future towards the more open soft sciences. Official science, he believes, has rejected this for too long and has thus contributed the current state of the social sciences.

economicus always striving for economic benefit, this presumption increasingly appears to act as a fundamental limit on understanding within that current of thought<sup>2</sup>. We should, moreover, add that moral hazard and negative selection in economic decision making have proved to be one of the main problems of economic practice in recent times<sup>3</sup>.

The second approach is represented by the heuristicists and the empirical economists including Kahneman, Tversky, and Taleb, as well as Robejšek and others who are aware of the basic fact that economic conditions in the world are inherently unpredictable. According to Taleb, who is one of the most distinctive of the current representatives of modern, unconventional thinking, the social sciences, markets, politics and the whole of society are fundamentally unpredictable, despite the vigorous attempts of economics, forecasters, mathematicians, statisticians and other academic experts and theoreticians.

According to these empirical and heuristic approaches, human beings are perceived as multi-criteria decision-makers who take into account subjective viewpoints as well as the ethics of economic interaction, and even emotions, and who, in reality, make decisions not based simply on how to maximize benefit. These facts are, indeed, well understood by cognitive psychologists and empiricists working in a completely different field from economics and focusing on the exploration of situations in which people are not endowed either with rational thought based on probability or optimal behaviour in uncertain and unclear conditions. Two exponents of this current of thought, Kahneman and Tversky, discovered so-called heuristic laws which are actually in conflict with human rationality.

### Randomness in Human Thought

The attempt of human society to anticipate the ambiguous definition of phenomena, especially in economic activity, has, of course, its roots in the second stage of the Cartesian type of thought. This developmental stage of seeking methods of determining conditions in the world, such as nuclear

reactions, the criteria for doing business, stock market speculation, insurance, gambling etc. is connected with the birth of thought based on probability as well as the enrichment of philosophical and methodological approaches by ambiguous reporting, multi-value probability logics and the statistical determination of random phenomena.

In history there has been a very wide spectrum /Daňhel 1991/ of opinions on the level of determinism of conditions in the world, ranging from W.Heisenberg, who regarded even physical reality as completely undetermined, through A.Einstein, who, in connection with certain undetermined physical phenomena (quantum physics), declared that he did not believe that "God" played dice, to J.Monod, who is an exponent of absolute determinism (ie. the determining of phenomena by finality), and Kolgomorov, who constructed the "zero unit" law, according to which, beyond the boundary of real time, chance turns into certainty and the probability of world conditions turns into a value of zero or one.

Discussion of the problem of how to analyse decision-making in uncertain conditions, was initiated in the 18th century by T.Bayes. Two schools of thought grew up in relation to his theorems: The first is the so-called Bayesians, or subjectivists, who thought it appropriate to include the subjective aspect of human decision-making in analysis, unlike the so-called "non-Bayesian" objectivists, who hold the opinion that it is better to omit subjective aspects from the formal analysis of the problem of decision-making. Recent developments, including the crisis phenomena of the second half of the first decade of this century, their causes and the analytical works of cognitive psychologists, behavioural financiers and empirical economists clearly show that, in the long historic debate, the Bayesians are right.

In connection with this, H. Raiffa /1978/ points out that analysis of the social-economic decision-making problems, in which the result of the decisions depends on unidentifiable world conditions, and shows that the basic problem is non-conflicting, although as the problem is refined, it is necessary to use ever more subtle methodological approaches, including mutually opposing ones, while each particular solution to such controversy has both pragmatic and philosophical consequences. The result is that the decision-making analysts, proceeding from their mathematical positions, disagree with each other about what advice to give to a practitioner in specific cases.

In some respects, the current trend towards globalisation reduces economic volatility and induces a sense of greater stability, while, however, leading to fragility and, therefore, greater market vulnerability, especially in the financial institutions. The result of

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<sup>2</sup> L. Mlčoch, in connection with this, refers to the work of A. Bašta, who, in the 1960's, formulated the concept of the interior model of the decision-making world, which was, to a large extent, in line with the principles of behavioural economics and the conclusions of the empiricists, and which is, according to Prof. Mlčocha /2010/ a much more interesting genotype than "homo economicus".

<sup>3</sup> In connection with this, we should mention the Czech economists A.Braf and J.Macek, the anniversary of whose deaths we are commemorating this year. Both men regarded ethics as an inseparable part of the economy and called for ethical consideration following practical theory. Braf defended the opinion that economic growth must take place with respect for the ethical aspect of social development. Macek /1947/ expressed the view that "our actions should be economical, just as they should be moral, beautiful and healthy".

this is that the infection can spread quickly leading to a domino effect. This is the starting point for the sceptical and anti-mathematical approaches<sup>4</sup> to risk management of N.N.Taleb /2010, 2013/, who has become a distinctive figure in the thought of the last decade. In his works, Taleb attempts nothing less than to change fundamentally our established view of the contemporary world, and, with great force of argument, to draw attention to the crucial role played by “unfettered” randomness in human life and society as a whole. These theses of the role of randomness have general application, but Taleb’s reflections on “the hidden role of chance in the markets” are particularly relevant to economic theory, which is somewhat at a loss in this respect. Taleb rejects the methods of statistical extrapolation and statistical modelling of the future using the Gaussian curve based on the conservation of past conditions and draws attention to the possibility of world conditions which lie outside the realm of predictability and, therefore, mathematical conceived definition.

The occurrence of world conditions generated by a random mechanism is, unlike Russian roulette with its clear, unambiguous rules and risk, characterised by the fact that we have no idea how big a “magazine” the generator has prepared for us. This is also true for economic conditions, and scientists, let alone mathematicians, can do little about it, because a meaningful response comes from observation of the generator, about which we usually know nothing. Despite that, in a period of economic boom, we tend to think that we are playing a game with a “more innocent” name than Russian roulette, and we begin, increasingly, to overlook risk.

#### **The Categorization of Methods to Support Decision-Making in Uncertain Conditions**

Methodologically speaking, the basis of decision-making problems in uncertain conditions is closely linked to the dialectic philosophical categories of necessity and randomness. A manifestation of necessity, natural relations and causality is the probability of a phenomenon, whereas randomness is neither a concept nor a category of mathematics. Unlike probability, it does not deal with quantitative aspects. Randomness is a qualitative (philosophical) interpretation, which presumes a view embracing the entire phenomenal richness of the world. Between necessity and randomness there is no antithesis (as Laplace, in his day, conceived them: randomness is necessity that has not yet been recognized by human beings). These two categories merge into each other, and the change in the level of observation takes place

in line with the dialectic law of the transition of quantitative changes into qualitative ones.

The relationship between the conflicting aspects of qualitative and quantitative interpretation is the content of concepts connected with randomness, such as risk, uncertainty and indefiniteness. The simplest decision-making problem is decision-making with risk, by which we mean a state in which the future situation is in advance unambiguously characterized by probability, meaning that the objective distribution of the probabilities of the occurrence of the individual values of random sets is known in advance.

A more complicated decision-making problem with uncertainty is considered to be a state in which the objective distribution of probabilities is unspecifiable. Uncertainty can be further divided into partial uncertainty, when complete information about the distribution of probability is not available, but some of its parameters are known, and complete uncertainty, when it is possible, at most, to specify a set of conditions for consideration, but not, however, to establish or even estimate the probability of their occurrence. In our understanding of the subject, the concept of partial uncertainty also embraces future situations characterised by subjective probabilities, which conflicts with the opinion of the insurance mathematician W.-R. Heilmann, who wrote /1987/: "In light of the fact that, with the help of subjective probabilities, it is possible to depict every situation in which there is a certain amount of incomplete information, it can be seen that setting a boundary between risk and uncertainty is not necessary". In the same spirit, R. D. Luce and H. Raiffa /1957/ interpret subjective probability as an estimator of objective probabilities.

Finally, the most complicated decision-making problem is decision-making with indefiniteness, by which we mean a situation in which, unlike uncertainty with its precisely defined quantities whose values are, however, unknown, the precise definition of the quantities and relationships are not known and can be characterised only by vague terms such as “considerable”, “approximate”, “slight” etc.

Although problems typical for decision-making with risk are not very common in economics, in today’s globalised and volatile economic world, one of most often used expressions is the term “risk”, which, without a deeper methodological basis is used almost exclusively in cases where other economic processes and activities with ambiguous or uncertain outcomes are being investigated, although decision-making situations are not, in the main, objectively characterised by probability in advance. From a methodological point of view, this is a completely incorrect use of the term, which can be understood as a synonym for situations connected with ambiguous

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<sup>4</sup> This is a manifestation of an attitude towards one of the most fundamental and, so far, systematically unresolved problems of the general methodology of science: the relation of dialectics as a qualitative interpretation of the conditions of the world, and mathematics as their quantitative interpretation.

outcomes. It has, however, no place in scientific texts.

From the point of view of investigation in this contribution, it is significant that the problems of decision-making with risk, that is, with known a priori probabilities of the occurrence of random quantities, are not very common in economics. Taleb cites, as an example of a problem of that type, a casino, where probability is known, Gaussian and almost calculable. In other words, gambling is a form of “tamed” or “sterilized” indefiniteness, unlike the real economic conditions of the world. Taleb /2013/ draws an important conclusion: From this point of view, Knight and de Finetti’s distinction between risk, which can be calculated, and uncertainty and indefiniteness, which cannot, makes no sense regarding the economic conditions of the world.

### **The Consequences of the Empirical Approach to Randomness for the Financial Markets**

A very apposite motto for this part of the contribution is a thought of N.N.Taleb: It is possible to calculate probability and, therefore, to measure risk in games with clear and explicitly set rules, but not at all in the real world. Mother Nature has not provided us with clear rules for any such task (Taleb /2013/).

Proof of the failure of the formalization of economic decision-making processes is the repeated defaults of model applications, beginning with the collapse of the LTCM hedge funds in 1998, which had winners of the Nobel Prize for Economics in their executive management, including the author of the portfolio theory R. C. Merton<sup>5</sup>, and ending with one of the triggers of the recent crisis – the Li model /Kovanda 2009/. From this point of view it is also necessary to subject to critical investigation the Value-at-risk method, which stems from quantitative risk assessment, as well as the “risk based approach”, which in the past was the principle generally accepted idea behind the perfection of the regulatory projects for the financial markets – Basel, Solvency, MiFID, IFRS etc. These ways of thinking are in direct conflict with equipping human beings to be decision-makers.

In the middle of the first decade of the new millennium, when crisis symptoms first began to

appear, the financial markets displayed a high level of engagement and activity in relation to the real economy, and it is, therefore entirely logical that the crisis should have begun as a fatal financial crisis threatening the total collapse of the world’s financial markets and seriously endangering the real economy. There is no doubt that in the global economy, the financial markets in particular, as a result of their high level of activity and autonomy, lost the ability to regain their balance, and it is therefore necessary to regulate them, if possible in conformity with the markets. The financial and economic crisis has indeed allowed politicians to argue that the economy, and the financial markets in particular, should be much more widely regulated to prevent a repetition of the crisis. The consequence of this was, and still is, political pressure for an extensive increase in regulation, but not for better quality regulation. This also applies to the further implementation of regulatory projects despite the fact that they are clearly insufficient to mitigate, let alone prevent, the crisis phenomena of the past: The crisis started on the most regulated market of all – the banking market.

It is, indeed, in banking regulation that the move towards greater bureaucracy can be seen most clearly. Whereas the initiator of the BASEL regulatory project, the Basel committee for banking supervision, an informal institution which organises discussion and cooperation between institutions involved in banking regulation, recommended rules for the world’s major banks, the European Commission made those rules compulsory for all the banks in the EU and, in addition, massively elaborated them. Although, as N.N.Taleb emphasizes, it is not possible to measure risk accurately, there is ever more literature and specific instructions in regulatory projects about how banks should measure, in particular, credit risk and other commercial banking risks.

As we have already noted, decision-making problems with risk, that is, with known a priori probabilities of the occurrence of a random quantity, are not common in economics. This thesis can be applied well to economic tasks in the specialized branch of the financial markets which attempts to resolve the economic consequences of randomness, in other words, the commercial insurance business. Working with randomness is, indeed, the basis of that business.

Insurance as a financial solution to the consequences of randomness is, from a mathematical point of view, irrational, with a negative mean gain (apart from paying out damages, the insurance company must cover its administrative costs and make a profit for its shareholders). Despite that, economic subjects take out insurance because the motives for it are closely connected with subjective human qualities – preferences and, above all, aversions, that is, with the

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<sup>5</sup> Taleb /2013 /points out the contradictory behaviour of R.C Merton, who presented himself as a fervent supporter of the official standpoint of the economic theory of the time, according to which, financial markets act efficiently, but, nevertheless, was later, together with another Nobel Prize winner M.S.Scholes, one of the founders of the above mentioned funds, and, therefore, anticipated profiting from market inefficiency. Merton created ingenious methods for calculating future risks, assuming that we know future indefiniteness too. In other words, assuming the world has clearly defined rules. It is a well-known methodological problem: how to subject the future to scientific investigation when, as an object, it does not yet exist, or, in other words, how to shift current conditions into the future.

domain of the “soft” scientific disciplines, especially cognitive psychology.

Most decision-making situations connected with insurance (the problem of a potential client whether to take out insurance against certain dangers, the problem of the insurance company when deciding what premium to set to cover the negative consequences of the danger) are examples not so much of decision-making with risk, but decision-making with uncertainty or even indefiniteness.

There is no doubt that insurance company managers and their mathematicians would like to consign decision-making problems connected with setting the optimal premium and a sufficient level of technical reserves to the area of decision-making with risk, that is, with a priori knowledge of the distribution of probabilities of a random phenomenon – an insurance case – for a sufficient length of time, so that the insurance technical models for calculating premiums would require merely a scientific discipline – the calculation of probabilities. Nevertheless, the reality of the insurance business is completely different.

Especially now in this globalized era, the assumption of a priori knowledge of the distribution of probabilities which a random generator would choose as its “game strategy” against the insurance premium set by an insurance company is completely without substance. There have been fundamental changes in the nature of hitherto insurable dangers (eg. The risk of flooding in Central Europe, hurricanes in America), while completely new dangers have emerged (eg. SARS, large-scale terrorism, computer piracy, environmental threats). These newly emerging dangers, some of which have consequences resembling those of hitherto insurable dangers (an explosion and fire caused by a terrorist attack), have come to be referred to in the insurance business as “unknown unknowns”, something insurers fear more than anything else, and which did not occur in the past and therefore have no past probabilities which could be included in mathematical models, provided we regard those models as functional. From the point of view of the categorization of the problem and the positions of the methods for supporting decision-making, it is a case of decision-making with indefiniteness modeled within the framework of the theory of fuzzy sets (the insurance event interval has a fuzzy upper limit)

Unknown unknowns are future conditions of the world, and no insurance mathematician has yet managed to shift the past conditions, under which past insurance events arose, into the future. The calculation of these so far unknown phenomena is governed by one of the basic methodological paradoxes – how to subject the future (future

insurance events) to scientific investigation when the future, as an object, does not yet exist.

It is apparent that Gaussian, ordered randomness occurs relatively rarely in the non-life insurance business. We could include in this category the insurance of motor vehicle accidents, where the interval of possible damages has the ceiling of the purchase price of the vehicle and there are probabilities of the level of various types of damage according to the statistical distribution frequency. We could also include accident insurance. On the other hand, insurance against the possible fatal consequences of, for example, natural disasters, or to cover liability for damage, displays the features of decision-making with uncertainty or even indefiniteness. Damage caused by an earthquake or the liability of the driver of a motor vehicle for a train accident at a level crossing display the symptoms of a right-open insurance event interval. As Taleb /2013/ puts it, the consequence of insurance for the insurer and the client depends on the generator of the conditions of “unfettered” randomness.

In current official microeconomics, within the theory of utility, there is the postulate of the so-called fair insurance premium, which is defined as a level of premium commensurate to the expected loss. The guaranteed income is equal to the expected income, meaning that the insured party has the same guaranteed income regardless of whether the loss occurs or not. Passages about fair and maximum premiums in expositions of mathematical elegance tend to be assigned in textbooks on macroeconomics to sections about decision-making with risk. I have never, however, in connection with that, read a warning that most of the non-life insurance business displays the signs of decision-making with uncertainty and indefiniteness, meaning that postulates about a fair and maximum premium are dealing with a fringe area of the problem with a tamed, sterilized randomness expressed by probability, and that for the greater, and more important part of the insurance business, that postulate does not apply. For the supporters of that theory it will be no easy task to refute Taleb’s arguments and construct an a priori fair insurance premium against, for example, the consequences of a hurricane, perhaps a future version of hurricane Sandy.

The consequences of Taleb’s unfettered randomness, which are manifested in the enormous growth in the financial losses caused by disasters, are, of course, beginning to come up against the barrier of the commercial nature of the insurance business. The combination of natural disasters with ever greater impact on assets, and the fragility of technological progress (eg. the tsunami at the Fukushima nuclear power station) raises a serious dilemma: Should the

commercial insurance business continue with its historical mission of trying to eliminate the financial impact of unfettered randomness, or even take on the “new challenges” of resolving the consequences of new threats, such as environmental damage or the cyber threat? Another possibility is to stick to its historical core business, or even to limit the level of insurance cover for hitherto insurable dangers.

As a result of the continuing desire to prevent the excessive volatility or even failure of the financial markets, the state regulators are currently giving priority to the stability of the commercial insurance sector in order to maintain balance on the financial markets, which is, of course, inevitably at the expense of the basic mission of insurance and the insurance business.

The mathematical modeling established by the Solvency II regulatory project, whose first pillar determines the acceptable ratio between the non-life risks covered by insurance and the insurance company’s capital resources, leads insurance companies to offer disaster insurance with limited validity. Insurance policies formulated in that way mean that randomness is “sterilized”, but they have a serious drawback – damage which exceeds the limit is not dealt with systematically. Once the crisis psychosis has died down, it will be the task of theory to find a balanced position between the original mission and sense of the insurance business and the possibilities of commercial insurance, which works on the principle of equivalence between income and expenditure.

To this principal dilemma we should add the opinion that, Taleb-style, when there is a real possibility of the occurrence of conditions in the world which lie entirely outside the framework of predictability and, therefore, outside mathematically defined definiteness, it is difficult to construct a scalar representing “non-life risk taken on” by an insurance company. At the same time, this, in our view speculative, quantity is used as a binding capacity criterion for commercial insurance companies. The Solvency II project, despite these obviously illogical factors, continues to lead a life of its own. Nobody now discusses its sense or the limitations of its application, and the hefty volumes of guidelines constantly published by self-important regulators increasingly resemble the content and style of Orwellian texts.

## CONCLUSION

The failure to master the complexity and temporal and special compression of the phenomena of today’s complex globalised world creates a completely new economic environment, has a serious impact on the state of the global economy and is becoming an urgent challenge for the social sciences and, above

all, a call for new economic paradigms. One of the most pressing questions in this regard is the level of determinism in the world today and the role of randomness in the life of societies and individuals. The school of thought that says that economic science should make use of greater formalisation and mathematisation to achieve greater rigour and, ultimately normative prediction, a position that has been typical for at least the last two decades, increasingly appears to be a dead end. The proponents of the open, soft scientific disciplines, which are better able to anticipate the consequences of randomness on the economic conditions of the world and to explain the behaviour of human beings as economic subjects when resolving decision-making problems in uncertain conditions, are gaining more and more followers. In this connection, it is significant that most economic tasks display the parameters of decision-making problems not with risk and the probabilities of the occurrence of a random quantity known in advance, but rather with uncertainty and indefiniteness.

The dilemma of anticipating randomness in economic tasks is clearly seen in the problem which is currently being solved by the insurance business, a historically tried and tested mechanism for the financial elimination of the consequences of randomness. The enormous growth in the financial consequences of disasters leads to pressure from the state regulators to introduce measures such as upper limits on the amount of damages paid, and exceptions from the obligation to pay damages, measures which certainly “sterilise” randomness and protect insurance companies from insolvency, while on the other hand reducing the effectiveness of insurance as a financial solution to the consequences of unfettered randomness. One of the important tasks of insurance theory will be to find a balance between measures to increase the stability of commercial insurance on one hand, and, on the other hand, the role of the business in solving the financial consequences of randomness, a balance which has been shifted towards a reduction in the volatility of the financial markets.

The basic idea of modern thinkers such as Kahneman and other heuristicists and Taleb and other empiricists is to reverse the process of cognition, not from reality to model, but rather from image to reality. In other words, to study the unfettered, unmapped and humbling indefiniteness of the markets and of real life as a path to understanding randomness or, to be more exact, its generator. They propose that we should free cognition from the current mainstream style of acquiring knowledge and abandon epistemic arrogance, the Platonic idea of precisely defined categories and all tools which do not take into account the enormous consequences of unfettered randomness on the markets and in life. In other words, we should rely on common sense while

being fully aware of the role of randomness in the consequences of our economic decisions, among others.

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