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THE FUTURE OF ECONOMIC MODELLING

This is the third in a trilogy of papers concerning the reform of Economics. This paper tackles the subject of Economic modelling, If modelling is a representation of reality then the concept of "what is real" must be discussed. A description of the purpose of modelling and the processes involved in creating models then follows. The debate then switches to Economic modelling, its purpose and its effectiveness. Traditional Economic modelling is still a useful tool for understanding and teaching but Data Analytics and intelligent algorithms are better for economic predictions.

Key words Ontology of Economics, Epistemology of Economics, Knowledge., Modelling.

1. Introduction

Economics is a young subject, often dated to the publication of "The Wealth of Nations" by Adam Smith in 1776. and was an attempt to understand economic reality [21]. Recently, there has been a groundswell of opinions about the poor state of Economics, both in theory and in practice [11, 15,18.,8, 12]. Among other things, Economics is accused of not being a Science, of using wrong assumptions, misusing mathematics and not being a reliable predictor of events. Some pertinent questions are:

a) Is Economics fulfilling its original purpose?

Is it possible to understand reality? Various views are discussed in section two

b) Are the tools used adequate?

The major economic tool is mathematics and a prominent methodology is the creation of models.,

c) Are the hypotheses (assumptions) used correct?

Hypotheses can be incorrect for many reasons, for example, known facts have been ignored, misunderstood or subject to cultural bias. Such situations can be rectified but what is difficult to handle is when there is no awareness of what is missing – Rumsfeld's "unknown unknowns" [19].

d) What is the current state of Economic Modelling?

Mason considers Economists more engineers ("homo faber") than scientists ("homo sapiens")? Is their quest to understand how the economy works rather than what it is? There is a difference between theory and practice, Current Economic theory is not interdisciplinary and must involve more research into communication, linguistics, communication, culture, psychology and neuroscience.

2. What is Reality/ knowledge?

To understand something, it first requires one to know what the thing really is? As Wittgenstein remarks "to know is to name." [25] What actually exists?

2.1. The Realist (traditionalist) View

The traditional view of knowledge rests on the premise that there is an objective reality which exists independent of "homo sapiens". Things exist" and our perception has no influence on them. As Plato wrote in his Theaetetus

"What is perceived must be there as perceivable beforehand" [10].

If this is so, then our intellectual efforts should be directed to discover what is already there. This is difficult as it rests on our perceptions which are a result of input data from our senses and its interpretation by our brain. There is a unicellular animal, without a central nervous system, called a Paramecium. It perceives reality (in the shape of obstacles) by manipulating small electric currents. The Catfish which lives in murky rivers where sight is no advantage build up its reality using Chemistry. It forms a 3-G D chemical map of its environment. There is a scorpion which builds up pictures of reality using vibrations. It can detect the movement of a grain of sand within its immediate environment. There are toads that can catch insects with amazing precision and speed but cannot see them if they are stationary. This is an example of the reality being a function of information processing in the brain. The reflected light from the stationary object will reach the tod's brain but for evolutionary reasons it is not processed. Its brain only processes motion.

So, what is real. When humans with our restricted range of frequencies see or hear something, is that real. Will the catfish, toads, scorpions agree with us?

2.2. The Constructionist View

There is a tradition going back to Protagoras and then Hume and Kant leading to Piaget and von Foerster that defines knowledge as a process not a commodity [17]. Whatever knowledge is, it is not objective i.e. independent of the observer. As von Foerster remarked *"Objectivity is the delusion that observations could be made without an observer*" [23].

Many cognitive scientists believe in a constructivist model of knowledge that attempts to answer the primary question of epistemology, "How do we come to know what we know?" [28] A constructionist reply is that Knowledge is constructed in the mind of the learner. There is a difference between knowledge and information. Information can be defined as the means by which knowledge is acquired. Piaget differentiated between physical, logico-mathematical, and social knowledge. The fact that a hall bounces or a glass breaks when dropped on the floor is an example of physical knowledge. Logico-mathematical knowledge consists of relationships between objects, such as comparing the way racquetballs and squash balls bounce. Social knowledge, such as the fact that soccer is played on days called "Saturday" and "Sunday", is based on social conventions. Learners construct understanding. They do not simply mirror and reflect what they are told or what they read. Learners look for meaning and look for regularity and order in the world even in the absence of full or complete information.

3. Modelling

3.1. Purpose of modelling

Knowledge consists of statements that accurately correspond to or match what exists in the real world. Model building is an attempt to produce replicas or copies of this reality. A model is deemed correct if it accurately reproduces what occurs and this results in knowledge. This is highly dependent on our view of reality,

To build a model, one needs assumptions, rules or procedures, inputs and outputs. The model is adjudged to be "correct" if its outputs (from certain inputs) correspond to known outputs (reality). Thus, ones view of knowledge (constructionist or traditional) will produce different answers to the following questions.

a) Is the behaviour, that is to be modelled, predictable?

In any complex system, the outputs can never be precisely predicted as the cybernetic paradigm is not deterministic. Von Glasersfeld [24] describes the construction of knowledge as a search for a fit rather than a match with reality. These concepts ("fit" and "match") are the difference between the constructivist and the traditional view of knowledge. In the traditional view where knowledge corresponds to or "matches" reality, two or more individuals with the same knowledge must have similar copies or replicas of reality in their minds. If knowledge "fits" reality, then this introduces subjectivity. Each of us builds our own view of reality by trying to find order in the chaos of signals that impinge on our senses. What matters is whether the knowledge we construct functions satisfactorily in the context in which it arises

Research by Argyris into how people behave has shown certain anomalies. The explanation of behaviour (espoused theory) is often different to the "theory-in-use" [2]. This can cause many problems. Argyris suggests two levels of behaviour: a single loop representing self-corrective processes (as exemplified by a thermostat) and a second loop which examines the underlying assumptions (or governing variables) [1]. When human activity is being modelled, roles may not be fully understood, An example is "bounded rationality"- the assumption that decision makers weigh up all actions before making the most rational choice. Recent work in neuroscience has confirmed that decisions are based on both rationality and emotion [6] which has resulted in alternative theories such as Behavioural Economics where decisions are taken heuristically [9]. This may explain why many predicted economic results do not in fact occur. In an attempt to remedy this criticism, economists often add extra assumptions, but this is like moving the deckchairs on the Titanic. If the premise (bounded rationality) is incorrect, and people do not behave as they "should" then the model is incorrect

b) What is the purpose of modelling?

A model is a construct of what exists in one/s head. The constructivist purpose is to further understand, to increase knowledge and to make sense of situations. This is always worthwhile. But, is it be possible to model every situation? The question should be "**Why** are we modelling something" as opposed to "**How** we are modelling it". The definition of a model can be modified to "*a simplified representation of*

reality ***built for specific purpose***" The model may have a predictive purpose but how much confidence can be placed in the prediction? The model may be built for control, then the outputs must be recognised as possible only if the parts being controlled behave as expected. This is achievable when machines or robots are modelled (excepting for wear and tear) but very difficult when humans are involved as humans have a tendency for non-linear behaviour which introduces chaos into the proceedings.

c) Are models correct and complete?

A constructionist does not know what the actual (real) rules and procedures are? There are "black boxes" where certain inputs seem to generate certain outputs. The workings inside the boxes are not known for certain. If one takes a traditionalist approach, it is a common adage that "*a model is only as good as the assumptions it contains.*" Assumptions are subjective, based on perceptions (both individual and communal). In both cases, it can be concluded that no economic model will ever be totally correct.

To deal with completeness is more difficult. Modelling is an iterative process which evolves. At each stage, the model can be checked against known inputs and outputs. There is no end to this process. Isomorphisms seldom occur. Models are calibrated to the accuracy of match that is desired. No model can cover EVERY eventuality and therefore will never be complete.

3.2. The process of modelling

The paper will distinguish between the traditional practice of modelling and a more recent practice using AI.

3.2.1. Traditional Practices

When it originated, Economics adopted the scientific paradigm and looked for causality and determinism in economic events.. Till now, the practice of Economics involves using metaphors to create analogous situations to real world situations. (which could be some economic theory or econometric equations, or a computer programme. The model (metaphor) will never be an exact replica of reality and is heavily dependent on the assumptions (context) behind the model. This context is the way we see things – our perception.

The traditional practice is shown diagrammatically in figure one which shows that a chain of feedback loops exists involving the relation of economic theory to reality and then the accuracy of econometrics and mathematics to represent the theory.

- Starting at loop A, our view of reality (which is formed from our beliefs) informs us of what exists and the causal links between them. There is a weakness here in that, in the authors opinion, there is no objective reality, but it is possible to agree on a reality. There are assumptions about the causal links between entities. Depending on whether you are a Keynesian or a neo classical you will have different views of how government spending affects an economy. The casualty that is adopted is the basis for Economic Theory (loop B) Cognitive Dissonance is the name for another problem which isn't uniquely pertinent to Economics. It is possible to put together a valid rational explanation of something and yet, at the same time, have a feeling that something is not quite right. One is holding the propositions "*p*" and " *not p*" simultaneously in one's consciousness. In such cases, what behaviour ensues? It is here that "self-deception "may occur. Self-deception can be defined as follows:

> *…the tendency to avoid affectively and cognitive demanding exploration and information gathering subsequent to the receipt of an error message in the interest of maintaining short term security* [7].

The theory is then modelled. (loop C) Assumptions have to be made about the behaviour of the economic agents. To avoid complexity many of these assumptions have been unrealistic such as markets always clear and that a human agent is always rational. The efficacy of the model depends on the assumptions and the validity of the theory. The model is an iterative process and whilst it will never be identical to the problem, it must be as closely related to it as possible. To immediately construct a model that contains every possible feature is impossible. One must therefore prioritise the importance of features (again a subjective exercise). Thus, the initial model is not expected to be accurate but only to serve as a guide to understanding. One by one, features are added, or relaxed, and better models evolve. One is improving the model by adding (or shedding) extra layers of understanding. One begins with a large list of assumptions and at each iteration, through a process of adding and discarding, produces better models. This is a skill and only comes through experience. Modelling is best done by a team with members possessing complementary skills.

The model can then be solved to make predictions (loop D). This involves selecting the most applicable econometric techniques. The economic solution obtained must now to be interpreted into a solution that relates to the context of the original problem. At some point after travelling around the loop several time, it may occur the solution is not the one that was expected. In this case, either the economic theory chosen is not adequate or the econometric techniques have been wrongly applied or interpreted. This will then lead to the search for better theories or techniques. No solution will be perfect. The iteration process does not end. Good modelling can be compared to making a good minestrone soup. You start with a few basic ingredients and add more and more making the soup better and better. Finally, predictions from the model are tested against the agreed reality which will then begin the whole process again.

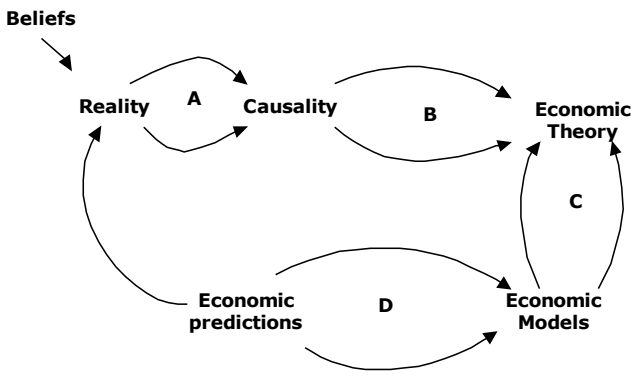

Fig. 1. The Process of Modelling

3.2.2. Modern Practices

This algorithmic approach began with the discovery of cellular automata (CA) [27]. These are models of a system of "cell" objects with the following characteristics: the cells live on a ***grid***; each cell has a state and a neighbourhood and there are simple rules that are applied at discrete time intervals This has now developed into Deep Reinforcement Learning (DRL). Reinforcement learning refers to goal-oriented algorithms. They use the concepts of agents, environments, states, actions and rewards. The algorithms are penalised when they make the wrong decisions and rewarded when they make the right ones – this is reinforcement. Hinton (a pioneer in artificial neural networks) introduced the term "deep" to describe the development of large artificial neural networks. DRL algorithms that incorporate deep learning have beaten world champions in various games. They operate in a delayed return environment, where it can be difficult to understand which action leads to which outcome over many time steps. DRL algorithms can be expected to perform better and better in more ambiguous, real-life environments while choosing from an arbitrary number of possible actions i.e. with time we expect them to be valuable to achieve goals in the real world.

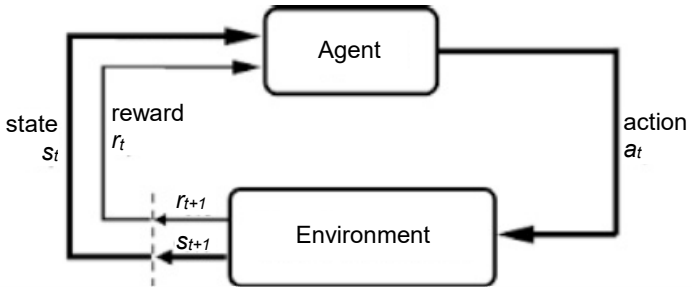

Fig. 1. Deep reinforcement learning credit Sutton & Barto

Reinforcement learning evaluates actions by the results they produce. It is goal oriented, and its aim is to learn sequences of actions that will lead an agent to achieve its goal or maximise its objective function. An economic example could be trying to attain a certain state (goal). We could set up 1000 agents with different strategies and observe their pathways towards the objective, They will be rewarded or punished after every action A complex probability distribution will be assembled which can be explored using Markov and Monte Carlo techniques. No formulas are produced. The agents are essentially reward-seeking missiles and the more times they run through the game, the more accurate their potential future reward becomes.

In 1997, IBM's Chess program Deep Blue beat the world grand master Gary Kasparov. This was a milestone in AI. In December 2017, Google's AlphaZero program defeated Stockfish, which was the current world computer chess champion. It had access to centuries of accumulated experience in chess as well as decades of computer experience. It could calculate 70 million chess positions a second. In contrast AlphaZero performed only 80 000 such calculations and its creators taught it no chess strategies. – not even standard openings. AlphaZero used the latest machine learning techniques – it taught itself! Out of a hundred games, AlphaZero did not lose one and won twenty-eight. Many of its winning moves and strategies seemed unconventional to human eyes. They may well be considered creative even genius. It took four hours for AlphaZero to learn and develop its genius instincts. It went from ignorance to mastery in four hours without the help of any human guide. When such creativity is added to the speed, efficiency and storage capacity of machines, we will indeed be in a new era and this is the challenge that Economics is facing [25, 20].

The practitioners have created their own reality which accurately mirrors what is happening. This the two loops collapse and there is only the problem of checking whether the pattern recognition is true. This is a mathematical problem and is easily verified. The data reveals behaviour – the AI uses the data to predict future behaviour – in the meantime future behaviour has taken place. Thus validation is simply checking the perceived behaviour against the observed behaviour and their interplay feeds back to improve the AI pattern recognition techniques.

The accuracy is very high and in fact the data is not only recording behaviour but creating it.

4. Evaluating Economic Models

How can models be evaluated? Several observations are made:

- A model is called "structurally consistent" if it contains no contradictions and it is self-consistent. Reasonable inputs produce reasonable outputs. It never "blows-up" in the sense that its outputs are never infinite. This is sometimes called verifying the model and relates to loop C in figure one.
- Given that the model is structurally consistent, is it doing what it is intended to do? Is it fulfilling its purpose? Is it valid? This could mean "is the model realistic or reliable or credible or trustworthy, or plausible or legitimate or accurate?" All these are common understandings of the word "valid." If one takes a holistic view, they are all implying that the user has "confidence" in the outcome. The user "trusts" the model. This can be at various levels.
- If one takes a holistic view, then it means that are the theoretical or philosophical assumptions behind the model correct? What is the epistemological justification of the model? (loop A) Karl Marx wrote of the "fetishism of commodities" That is the idea that market transactions disguise social relationships as relationships among things, rather than revealing the deeper truth that they are relationships among people [4].
- If one looks at the operational level, then, does the model use terms that are generally understood and accepted in the field. Are the inputs to the model are precise and taken from published results? Do the outputs bear out what would be expected from these inputs i.e. are the outputs are reasonable? If so, the model could be classed as valid .(loop B)
- At a more micro level, is the model applicable and practical. (loop C) Can it be used by practitioners and are they "confident" in its performance. This surely is a good justification of a valid model – it is accepted by its peer group.

These three levels of validity are examples of what C.S Pierce called "Abduction." Most people are familiar with the terms "deduction" and "induction." The first is when a

general situation is observed and from that particular patterns are inferred. This is best exemplified by the stories of Sherlock Holmes – from a general observation of a person's clothes, Holmes could deduce his profession, religion, marital status and even his social habits. The second process "induction" is the reverse. Here one starts with lots a of particular examples and from them postulates a general principle or rule. It is often used in mathematics where first one proves that if some state has a particular quality, then so does the next. Then, when one observes it for a particular state, it is valid for the next and the next and thus for all states Abduction lies between the two. If we have a model that is structurally sound and does not behave abnormally, then, if precise and correct inputs are fed into the model and skilled practitioners accept that the outcomes are reasonable, abduction can be used to declare that the model is valid. Peirce explains the structure of abduction in his account of Kepler's discovery of the elliptical orbits of the planets–"the greatest piece of [abductive] reasoning ever performed"–as a series of steps, each responding to an inductive failure to fit the data precisely, in which, using the resources of analogy and the constraint of conserving the quantitative successes already achieved, as well as insights from the nature of the failure itself, a simpler hypothesis is replaced with a more complex hypothesis [16]. On the other hand, such a conservative procedure sometimes becomes stymied, and a greater abductive leap may lead out of the impasse, just as Copernicus's qualitative solar-centric hypothesis overthrew the very basis of the Ptolemaic geocentric system, which itself had undergone centuries of conservative abductive changes.

- Many econometric techniques are valid only for a prescribed set of assumptions e.g. a specific probability distribution. For any other distributions, the model is not valid. It should not be used but it often is! Some economists make the distinction in building models for theory (which is a product) and for theorising (which is a process). According to Swedberg, [22] modelling is the "art" of good guessing, and its aim is to give the user useful advice about developing tentative explanations.
- Are we sure of the inputs? First, are the inputs measurable? If so, to what accuracy? Results from Quantum theory have shown that at the atomic level experiments are not repeatable. It is impossible to take accurate measurements as the entities being measured are the same size as the photons in the observation. Most models do not delve into the atomic level, especially economic ones, but there is still some truth in the statement that experiments are not repeatable. The reason being that if humans are involved then learning takes place. Secondly, only permissible inputs should be used. For instance, if the model requires the number of staff employed, it is not permissible to input "20.678". Similarly, the model would not output such a number in this situation.
- A major problem is forecasting – predicting outputs in the future. Many economic models attempt to predict events or financial values for the next quarter or next year. In many situations, it is expensive to physically do something so a model is built to aid decision making. Building the model is much cheaper than the action itself and has no harmful consequences. Experiment with the model rather than reality and save costs. This is a sensible course of action but the accuracy of the model will not be known till the date (in the future) is reached and a match can be made. This one is making decisions under uncertainty and the consequences are unpredictable.
- There is always the possibility that, by chance, a bad model can produce acceptable results. The Duhem-Quine Hypothesis presumes that every model has core postulates and auxiliary hypotheses [5]. The hypothesis is that it is possible to preserve the core theory, T, in the face of apparently contradictory evidence by adjusting the auxiliary hypotheses. The adjustment could be a positive fix (independently confirmed) which will rectify the issue or to replace the auxiliary that has been criticised and insert a new one. There have been apparent successes for this hypothesis – the most quoted one being the discovery of the planet mercury. Newtons Theory (T) was not predicting the correct orbit for Neptune so an auxiliary assumption was proposed – there is a yet undiscovered new planet. That planet (Mercury) was then discovered. But there were still anomalies. Another planet was proposed and found (Uranus). The danger can be seen – that one fix leads to another fix and one enters into an infinite regress. Newton's model is based on the assumption that there is an unseen, undetectable force, present everywhere in the universe, called gravity, by which all material entities are attracted to each other. Using this model, Newton constructed his theory of gravitation which perfectly explains every known phenomena of the time – the movement of the moon round the earth, behaviour of meteors, the reason behind the tides and even why apples fall to earth. At the time, it was the most successful model ever built but, in fact, the core premise is incorrect. The gravitational force does not exist. The match between the aforementioned phenomena and reality only occurred within a limited range of values. Once, one studied the very small (nanotechnology) or the very large (cosmology) the match did not exist. It needed a new theory (Einstein's Theory of General Relativity) to explain gravity. Thus, the authors reject the Duhem-Quine Hypothesis.

5. The Future of Economic Modelling

By now, one may be wondering if there is any sense in building economic models. The answer depends on how one regards the purpose of Economics. If one resides in loop D, then economics is the efficient use of a model to predict a particular outcome. The advent of Big Data Analytics, Intelligent AI and sophisticated algorithms is very efficient in doing this and will eventually usurp this aspect of Economics. If one, as this trilogy of papers suggest, takes a system view, then economics is part of a bigger picture. The political ramifications of an economic theory (neoliberalism, Keynesian, Classical) shapes out lives. Is the reason for increased wealth a trickle -down or a trickle-up effect? Does demand create supply and if so, how does this fit with the preservation of the Earth's natural resources. How does one measure inequality or wealth or happiness? These questions illustrate that economic theory, political theory and social theory are totally interconnected and must be tackled together. They are similar to the PDCA process used by Toyota- PLAN (economic theory), DO political theory) CHECK (Social Theory) and ACT. But there are large time delays here. It takes time for economic ideas to permeate into government, time for them to be put into practice and then time for them to reveal the consequences. There is then discussions around the measures used to assess the consequences and how they trace back to the theory or the implementation. There needs to be a framework to debate and discuss these questions. This is why Economics is important and has a future. The more the general population is aware of economic theories and their consequences, the more consensus can be obtained between the governors and the governed.

The authors propose three good reasons for economic modelling.

- The first reason is that the process of modelling is in itself a useful and rewarding endeavour. By creating models, one is thinking and by thinking and learning, one is acquiring

knowledge. The purpose of the modelling is not to reflect an objective reality but to empower us to act effectively in the world of our experience. We are then acting to fulfil a purpose which we have ourselves chosen. Our model is not designed to reparent reality but to discuss how reality fits to an accuracy that we determine. Maturana [13] states "to *know, means to act effectively*" [14] gives the following guidelines to the modelling policy:

> *We must admit that a model may confirm our biases and support incorrect intuitions. Therefore, models are most useful when they are used to challenge existing formulations, rather than to validate or verify them. Any scientist who is asked to use a model to verify or validate a predetermined result should be suspicious"*

- The second reason is that the process of building the model will involve interaction with one's peers and not only in the economic field. It will promote economic., political and social debate. Whether this is by reading, discussion or instruction, the model builder is never alone. Thus, there is a considerable increase in communication skills, interdisciplinary activity and teamwork.
- Finally, in building the model, one will evaluate and question the number of variables that are involved (including some which were previously unknown). This is a starting point for better diagnosis. An example is the Viable System Model of Stafford Beer. Beer [3] claims that this model is the template for viability (survival). If a system does not match to this template, then it will not survive over the long term. The constructionist will dispute this statement but nevertheless, the model forms an excellent basis for diagnosing.

6. Conclusion

This paper examines the art and purpose of economic modelling. The common definition of modelling is " a simplified version of reality" The authors believe that there is no objective economic reality only an agreed constructional one, so this definition needs refining. The paper identifies economic modelling as a process consisting of four stages and discusses the strengths and weaknesses of each stage. The first two stages result in an economic theory which involves assumptions about the cay uses and effects of economic behaviour. The third stage involves the general art of modelling and the final stage is the use of econometric and/or mathematical techniques to predict outcomes. When econometric techniques are used to validate this model, what is being matched (or verified) is the fit of the mathematical n model to the theory not the theory to reality. It is not possible to do this second match as both reality and the theory are subjective. The process is in fact creating a model of a model of one's perceptions and prejudices and a s such is highly contentious.

This dilemma is not present when data analytics and algorithms are used as no model is created. What happens is that massive amounts of data concerning real behaviour is collected and analysed to predict behaviour. The algorithm (and its creator) don't know WHY or HOW the result or prediction is obtained only that this is what will happen. The problem here is that there this method does not depend on theory. In a sense there is nothing to explain. It requires a certain amount of blind trust but the successes of this approach is everywhere and can no longer be ignored. But still, any such decision must be explained, and the populace must be persuaded that this is the right way

The final section discusses the purpose of economics and takes a system view in that economic science cannot or should not be separated from political and social sciences. They are all inseparably entangled and to concentrate one and not the others is meaningless pedantry. Thus, a dual purpose is proposed which uses the strengths of two approaches. If one is forecasting human behaviour, then the rise of intelligent algorithms which gradually replace economics. If however, one is to try and make sense of life, how it can be lived and how it can be governed, one needs a fabric on which to weave ideas of many different colours. This is then the other purpose of economics. It is a way to discuss, debate and understand what possibly is happening. Such debate is part of the educational process and involves peer – to -peer contacts and social communications. The danger which must be realised and included in the de bates is that the backdrop is not an objective reality. Part of the process is agreeing on the reality before constructing theories to match it. The authors are aware that this is a chicken and egg situation but so is the advancement of all knowledge and enlightenment.

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МАЙБУТНЄ ЕКОНОМІЧНОГО МОДЕЛЮВАННЯ

Це третя робота в трилогії статей про реформу економіки. Дана стаття присвячена темі економічного моделювання. Якщо моделювання являє собою уявлення про реальність, то необхідно обговорити поняття "те, що реально". Далі йде опис мети моделювання і процесів, що беруть участь у створенні моделей. Потім дискусія перемикається на економічне моделювання, його мету і ефективність. Традиційне економічне моделювання, як і раніше, є корисним інструментом для розуміння і навчання, проте аналітика даних і інтелектуальні алгоритми краще підходять для економічних прогнозів.

Ключові слова: онтологія економіки, епістемологія економіки, знання, моделювання.

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БУДУЩЕЕ ЭКОНОМИЧЕСКОГО МОДЕЛИРОВАНИЯ

Это третья работа в трилогии статей о реформе экономики. Данная статья посвящена теме экономического моделирования. Если моделирование представляет собой представление о реальности, то необходимо обсудить понятие "то, что реально". Далее следует описание цели моделирования и процессов, участвующих в создании моделей. Затем дискуссия переключается на экономическое моделирование, его цель и эффективность. Традиционное экономическое моделирование по-прежнему является полезным инструментом для понимания и обучения, однако аналитика данных и интеллектуальные алгоритмы лучше подходят для экономических прогнозов.

Ключевые слова: онтология экономики, эпистемология экономики, знания, моделирование.

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УДОСКОНАЛЕННЯ ІНФРАСТРУКТУРИ ОБ'ЄКТІВ РОЗМІЩЕННЯ ТУРИСТІВ В УКРАЇНІ

Метою статті є дослідження інфраструктури об'єктів розміщення туристів в Україні та виявлення можливості її удосконалення. З'ясовано відсутність зафіксованого в нормативно-правовій документації чіткого трактування основної галузевої термінології та визначення належності об'єктів тимчасового розміщення до певної класифікаційної групи. Це призвело до того, що вітчизняною нормативно-правовою базою передбачено можливість встановлення категорії лише одному їх типу – готелям. Виявлений факт обумовлює вузьку спеціалізацію вітчизняних об'єктів тимчасового розміщення (надання тільки готельних послуг), знижує їх міжгалузеві зв'язки та є однією з причин стійкого збільшення лише кількості готелів при зменшенні загальної кількості об'єктів. Визначено за необхідне привести у відповідність нормативно-правове регулювання діяльності об'єктів тимчасового розміщення туристів, закріпити застосування чіткої одностайної термінології.

Ключові слова: об'єкти туристичної інфраструктури, об'єкт тимчасового розміщення, засіб розміщення, готель.

Постановка проблеми в загальному вигляді та її зв'язок із важливими науковими або практичними завданнями. Наразі в Україні склалася вкрай складна соціально-економічна ситуація. "Ефективним засобом сприяння соціально-економічному зростанню для усіх країн" є туризм, що було визнано ще в Гаазькій декларації "Міжпарламентської конференції з туризму" (1989 р.) [1, принцип II]. Цей факт і понині підтверджується значною кількістю статистичних даних як для окремо взятого регіону, країни, так і для усього світу. Враховуючи, що сфера туризму "стає однією з основних галузей, яка впливає на загальний стан і тенденції світової економіки" та визнаючи її високу рентабельність для національної економіки, Кабінетом Міністрів України схвалено "Стратегію розвитку туризму та курортів на період до 2026 року" [2]. У ній основними цілями розвитку передбачено [2]:

- створення конкурентоспроможного національного туристичного продукту;
- спрямування діяльності на чітке позиціонування різних видів туристичних продуктів, адаптованих до вимог і очікувань споживачів;
- підвищення якості інфраструктури курортів та рекреаційних територій;
- забезпечення відповідності ціни та якості туристичних продуктів шляхом створення умов для оптимізації