An answer to the triple crisis: a human based economic model

Abstract

The mainstream economic theories have strongly contributed to the crisis in economics, society and environment by legitimating a society that embraces inequality and sustains the destruction of the environment. Unfortunately this led to the common belief, that the problem is in the mathematical nature of the mainstream economic theories. However, a strong mathematical basis is key for successful forecasting and a sound mathematical economic theory does not have to lead to the above cited problems. In the mainstream economic theories the key problems are the axioms applied, as they contradict the observed economic behaviour of humans. In this paper a basis for the mathematical description of economic processes that is in accordance with the experimental observations of social sciences is presented and the basis is set for an economic theory without using obviously untrue terms like optimisation, equilibrium and the assumption that one has full knowledge. The theory relies on axioms that lead to the description of the agent, the economic activity and introduce time-dependency. The aim is to provide a stable mathematical basis for those, who try to describe and understand economics based on their observations – and not for those, who try to change their observation to fulfil their expectations.

Introduction

In an era when we can read things like „Economics has failed us: but where are the fresh voices? Mainstream economic models have been discredited. But why aren't political scientists and sociologists offering an alternative view?"[1] we know that there are deep problems. However, the quotation does not show that economics and implicitly mathematics doesn't work, but that mathematics wasn't used in the right way in economics. For example, if we have a look, we can see that in mainstream economics the basis is the mathematical theory, and from it the economic theory is derived and then the humans are expected to live and act according to the original mathematic theory. This could be good and useful only in case the mathematic theory would describe the human behaviour. However, as this might be the case, but not the only case – and as we have seen lately isn't the case – a theory is needed, that starts from the human behaviour and while developing the mathematical description it keeps in mind that it is only useful if it describes the reality.

In this paper we try to show a way to use mathematics in the right way for the sake of creating economic description that represents the real-world human behaviour. We do not claim to provide a full description without simplifying the reality, as already John Stuart Mill pointed out that simplifications are important for economics to be different from social sciences.[2] The important question is which simplifications are needed and are acceptable. We aim to provide a stable mathematical basis for those, who try to describe and understand economics based on their observations – and not for those, who try to change their observation to fulfil their expectations. We

[1] Aditya Chakrabortty, "Economics has failed us: but where are the fresh voices?", *The Guardian*, 16 April 2012, http://www.guardian.co.uk/commentisfree/2012/apr/16/economics-has-failed-us-alternative-voices

[2] John Stuart Mill, "Essays on some unsettled questions of political economy", 1844

are aware that this is very difficult to achieve, as our theories strongly influence our observations,[3] but on the other hand we feel the need to point this out as a principle.

Why do we need a completely new theory? It is true that the „old one" is often criticised, but couldn't we just ameliorate it? Yes, that would be the easy way, but to the authors of this paper it seems that it does not lead to an acceptable result. Not only because there are philosophical mistakes in the neoclassical equilibrium-based theory – for instance, when have you seen equilibrium in your life? In mainstream economics we often talk about equilibrium, and try to describe non-equilibrium processes. It is like trying to listen to a track without the sounds on.

The reader might say: there is a lot of criticism, we all know, but there is no other way than the mainstream economic description, or is there? Yes, indeed there is, especially if we want to get out of the triple crisis. This article will show the first step on a long journey, that may provide us with useful results – that we can see a mathematical description, that actually works, has strong relations with the reality and is not over-complicated.

The theory

When creating a mathematic description, we suppose that some axioms are true (this is the case for the neoclassical model as well, however, there the axioms are foggy and there is no general consensus about them – but as this article does not focus on criticising the neoclassical model, but to build a new and better one, we won't go into details about them). In our case these axioms are the following:

1. The aim of the economic activities is enrichment
2. An economic activity consists of decision, execution, results
3. There are economic activities, that involve the simultaneous actions of two or more agents

These three axioms are – according to our knowledge – true in the world observed around us. So from now on we will focus on describing the agent, that possesses goods and makes economic activities – and as the agent is not alone, we will also describe the interactions between the agents.

The difference of the present approach from the mainstream is that we introduce the wealth of the agents as the quantity of the goods (material and symbolic) owned by the agent. The aim of the mathematical theory is to describe the time dependence of the wealth of the agents. If it is done for all the agents, then it gives the description of the whole economy.

The agent

Our unity is the 'agent' that can be a human, a factory, a family or any economic entity (firms, agencies). The agent has its specific goods-basket, goods like money, health, milk, books, and so on. As the different goods and their dependence and interdependence have no influence on the basis of the theory, we do not need to introduce restrictions for them. So, based on this, the wealth of the agent *a* is a vector, where the components are the quantities of goods owned by the agent, index 0 is for the money, and number of distinguished goods is *n*:

$$X^a\ (0,1,2,3,....n) \qquad \text{equation 1}$$

where *a* represents the agent and *X* the sum of the goods and commodities of that specific agent. As the state of the agent changes in time, this function is time-dependent as well. Therefore:

[3] Edward Fullbrook, "To observe or not to observe: Complementary pluralism in physics and economics", *Real-World Economics Review*, issue no. 62, 2012, pp. 20-28, http://www.paecon.net/PAEReview/issue62/Fullbrook62.pdf

$\underline{X}^a(t)$ equation 2

The time-dependence comes from two factors: one of them describes the changes, that are influenced by the agent (D) and the other one describes the changes that are happening just as the time goes by, like amortisation, loss and so on (K):

$d\underline{X}^a/dt = \underline{D}^a(t) + \underline{K}^a(t)$ equation 3

Comparison of our theory to the neoclassical theory

In the neoclassical economic model the activity is described only by the result, details of the action is not considered. Nevertheless the action takes place in a finite time, so there is a time-lap between the decision and the result, namely the time needed for execution. In economic modelling one possible solution is the discrete time, meaning that the interval that we take as a unity must be longer than the time needed for the execution. Additionally, discrete time means that one has to handle all the actions belonging to the interval as simultaneous actions. It means that instead of the individual actions we have to describe the result of all the actions belonging to the time interval. A possible solution is time aggregation, that is: one sums up for all the actions starting in the selected interval. The time aggregation changes the behaviour, so it describes not the real (real time) behaviour, but a "smoothed one", therefore the real agents will be transformed to economic agents, whose properties will depend on the method of time aggregation.
We also use this type of aggregation in our theory.

In the neoclassical economic model, however, there is an other aggregation as well. They aggregate for the activity types and for the partners. Only the actions involving the other agents, and actions selected and done with one agent are distinguished. First is called trade, the second consumption/production.

To avoid this second aggregation, that takes us far from the reality, we introduce a new concept, the intensity. We call two activities belonging to the same type, if they involve the same agents, and if they change the same goods, and furthermore the ratio of the quantity changes is the same for all the goods. The activities belonging to the same type will be identified with the upper index *abl*. Where *ab* identifies the agents involved in the action (the generalisation for more than two partners is straightforward). One element is selected as the unit element, its activity will be $\underline{e}^{abl.}$. *The ratio of the quantity changes of the actual and the unit activity will be called intensity.* The result of the (*abl)*-th activity is rewritten in the form

$\underline{q}^{abl} = I^{abl} * \underline{e}^{abl}$ equation 4

where $\underline{e}$ is the unit activity, $e^{abl}{}_j$ gives the change in the good vector of the agent a in the j-th unit activity with agent b, and I^{abl} is the intensity of the activity.

The aggregated change of the j-th good of agent a is

$d\underline{X}^a = \Sigma_{b,l} I^{abl}\, \underline{e}^{abl} + \underline{K}^{abl}$ equation 5

The resulting activity of agent a is described by the cumulative activity intensity, I^{abl}. There is no trivial optimisation criteria for the selection of the cumulative activity. Nevertheless there is an observation. The higher is the expected gain the higher is the willingness to act. It suggests a novel formulation of the governing principle of the decision, that is that the intensity of the l-th action of agent a with agent b depends on the expected gain of the action of agent a (or in many cases we can even assume the proportionality). Similarly, the intensity of the l-th action of agent b with agent a

depends on the expected gain of agent *b* for the action. The action can be realised if the choices of agent *b* and agent *a* corresponds to each other. This constraint will lead to equations which define the price and the intensity.

Due to the omission of an aggregation, this approach is more complex and complicated compared to the neoclassical one (for further details see the bibliography).[4] Furthermore, it requires parameters which must be gained from the observation of the real behaviour. In the present stage only some simple "ideal models" have been investigated. The robust result is that the economic system more likely tends towards cycles or chaos than equilibrium.

Discussion

The approach presented in this paper compared to the neoclassical approach

As till now the neoclassical economic theory is the most widespread and widely referred to mathematical economic description, we feel the need to make a light comparison between the model presented in this paper and the neoclassical theory.

Axioms

The axioms needed for the theory presented in this paper are explicitly stated in the beginning. There is a general consensus about that the neoclassical theory is based on the description of a system in equilibrium – however this assumption is evidently not true in everyday life, and therefore it is important to state, that the theory presented in this paper does not require the assumption of equilibrium.[5]

Focus

Further differences are that the neoclassical economic theory has as an aim to provide an elegant mathematical solution. This aim has been fulfilled, however only by making compromises in the description of the human behaviour. This lead to the trend observable nowadays, that many people claim that the problem lies in the humans, if humans behaved like in the neoclassical theory, the theory would work. However, in the theory presented in this paper the focus is on the human behaviour – that we do not think that we have the task or right to change, but to give a mathematical description of it – as close as possible to the reality.

Aim

We shouldn't judge the neoclassical theory, as one of it's aims, to give a mathematically correct description, is the same as ours. The problem does not lie in the theory but how it is used. It is not considered at its place – as a model that is valid when its axioms are valid. We will show in our future papers that in case we accept the assumptions of the neoclassical model, we get back the same results with our description as well. Further differences and their consequences will be shown in our following papers.

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[4] Katalin Martinás: "Is the utility maximum principle necessary?", In: Crisis in Economics. Editor: E. Fullbrook, Routledge, London, 2003.
Katalin Martinás: Neumannian Economy in Multi-agent Approach. Investigation of Stability and Instability in Economic Growth, Interdisciplinary Description of Complex Systems, 2, 70-78, 2004.
Zsolt Gilányi, Price Theory And Money Coupled: Some Remarks On The Ayres-Martinás Theory. Interdisciplinary Description of Complex Systems, 11(1), 29-36, 2013

[5] Emmanuelle Benicourt, Bernard Guerrien, "Is anything worth keeping in microeconomics?" *Review of Radical Political Economics*, Volume 40(3), 2008, pp. 317-323

Discussion of possible difficulties in the acceptance of our theory

From the sociological point of view
We have observed that there is more and more doubt about mathematical economic theories – see the quotation in the introduction. As our description is mathematics-based, we fear that many of those who would be interested in and supporting our ideas, simply throw it away without giving it a chance. We understand these fears, as in many mathematical descriptions mathematics became the master and did not stay at its place, as a slave. What does this mean? That the theories lost their relations to the real-world events and therefore they do not describe them any more. What is worse, following them led us to the triple crisis, observable nowadays. In our case, however, we paid attention to only use mathematics in accordance with the reality as much as possible, so we claim that we describe economic processes that are in accordance with the experimental observations of social sciences.

From the mathematical economics point of view
We fear that mathematical economists have to go a long way to be able to fully accept our theory and work with it, as on one hand, the neoclassical economic theory is much more developed, detailed, than the theory presented above. However, it is already widely accepted, that the neoclassical theory does not work well-enough, but for some the hope is still there, that with some little changes it might work. On the other hand, our theory might seem for the first read very basic, too common-sense to be interesting to take part in further developing it.

Discussion of the possible advantages of our theory
We strongly believe that despite all the above mentioned problems, the theory presented in this paper helps and will help to provide a better understanding of the socioeconomic processes – and by further evaluating and differentiating the theory presented here most of the problems created by the neoclassical theory can be overcome, as for example it resolves all the unresolved issues stated by Helbing[6]. Here we present some advantages of our theory.

Closer to the reality
Our theory is based on the observable human behaviour and when introducing new variables and mathematics, we refer to the reality. We do not introduce evidently not true elements hoping that finally the theory will describe the reality. Therefore we can be sure that the theory will be strongly related to the reality and we won't mix the roles of mathematics and society – mathematics is the slave, the society, the humans are the master.

Transparency
The theory presented in this paper is transparent, we do not try to hide axioms, assumptions, or include assumptions that are as per se wrong, just for the sake of the mathematical beauty. Many things that are usually introduced in economic theories at a later stage in the development are included in the first building blocks of the theory presented here. For example in our theory we do not have to introduce that the agents have restricted knowledge, it is included in it from the roots. Or we do not have to restrict the independent variables of the agent – the various variables are present from the beginning.

Complexity

[6] Dirk Helbing, „Economics 2.0: The natural step towards a self-regulating, participatory market society", *Evolutionary and Institutional Economics Review,* in print (2013), see http://arxiv.org/abs/1305.4078

The mathematical approach described above gives an adequate framework to describe our strongly coupled society as it is, without the need to decouple it; therefore our description is a good reply to the explicitly formulated need for a system-based theory.[7]

Conclusion

In this paper we presented a basis for the mathematical description of economic processes that is in accordance with the experimental observations of social sciences. Our theory relies on the axioms that lead to the description of the agent, the economic activity and introduced the time-dependency. We managed to set the basis of an economic theory without using obviously untrue terms like optimisation, equilibrium and the assumption that the agent has full knowledge. This description gives a fertile ground to be further developed, and in the following papers – based on this approach – we will talk about preference vs. utility, compare Homo Oeconomicus and Homo Sapiens Oeconomicus and we will give a description for the market. Finally, the present description of economic activity allows a unified description, where the natural constraints are built in.

[7] Dirk Helbing and Alan Kirman, "Rethinking economics using complexity theory", *Real-World Economics Review*, issue no. 64, 2013, pp. 23-52, http://www.paecon.net/PAEReview/issue64/HelbingKirman64.pdf
Katalin Martinás, „Complexity and the Role of Interactions", *Complex Societal Dynamics: Security Challenges and Opportunities*, (edited by K. Martinás, D. Matika, A. Srbljinoviæ), NATO Science for Peace, Series IOP, Amsterdam, 2010. pp. 65-79.