

Answer to the Question

What is Money: Gauge

Freedom

Physicist's approach to tendencies in world's economy

Dainis Zeps

dainize@mii.lu.lv

Institute of Mathematics and Computer Science

March-April 2009

Abstract

We suggest new approach to what should be considered money. We argue that not money itself should be measurable quantity but change of it, thus, entering gauge freedom action in economics in analogy with what we perceive what concerns nature how it is described by theoretical physics.

Key words: world's economy, money, gauge freedom, physics, commonwealth.

Introduction

In previous article (1) we forwarded question what is money, what quantity measures money, and so like. Now we are trying to answer this question in a way physicist would do to solve world crisis problem. In (1) we argued that theoretical physics has reached excellent insight in the forces of nature and we mentioned gauge principle, which has given us general pattern how to derive from this general principle all forces of nature (2). In this article we come to conviction that just gauge freedom is this aspect that has been overseen in modern economical theories and should be now reestablished in its proper position. In the same time we understand that our approach may seem unrealistic and even fantastic, but nevertheless we are convinced that the direction suggested in this paper have very reasonable ground and because of this fundamental reasonability of this idea it may be attack if not today then in future.

How to introduce gauge principle in economics? We know well a general principle that money is what makes more money. What does this mean if we try to follow the idea literally and scientifically? Actually this would mean that not money itself is doing or producing something but change or exchange of money. We may have heaps of money, either in banks, or hidden somewhere under ground, or in whatever place without being set to work, but this money would be only nominal money but not actual, working money. Let us assume that we have only money in case we do something with it, otherwise we do not have it at all, or at some level of being undefined what concerns value. It is clear that this type of money should be something quite different we understand under money today. What we would understand by this state of being undefined? From what we have already, it may be stolen, first of all. It may be losing its value in case of changing economical conditions. It may lose its value, or gain, by legislative actions of nation where particular money works.

What difference this makes to think about money as some changed but not fixed quantity? For physicists the difference is crucial, because just gauge freedom starts to work where some quantity is undefined but difference of this quantity is working. Immediately we must warn that we should be ready to start to think in more general terms about money than we are used in today's economy, where we behind money understand something fixed by traditions what concerns its functionality and whatever else. If we want money to gain gauge freedom we must think of it as quantity that does exist only in its changing capacity. How to reach this? First we must say ourselves that we must invent completely new forms of existence and functioning of money. If we succeed, we get completely new economical existentialism, that would rise our civilization onto completely new level of development. Such notions as capitalism, communism, socialism would become picturesque pages of our history, we would reach new level of commonwealth with new economical laws at work.

But, alas! we are so used to think about money in its absolute value, thinking of it as some measure of our wealth and security. What we have spared in banks shows our prosperity, our economical security and stability. Could we be ready to resign from this form of security? What we would receive in turn? Yes, what we would receive in turn? this article is just trying to suggest answer to this.

But one more crucial thing. And this concerns the crisis in the world's economy nowadays. We would be put in situation where we do not have choice, to change ourselves to gauged money and to rescue ourselves, or to keep old money and go down. Contemporary crisis may force us by most violent strength to go to new concept of money. We would have two choices, either to die (with heaps of nominal dead money in banks), or to survive via new gauged money. In this paper we are going to warn reader that we might not have any choice if we want to survive.

What is gauge freedom in theoretic physics?

We start with picture where sparrows are sitting on electric wires. What physical law allows them to sit there? Why they do not fall down shocked by electric current? The corresponding physical law is very simple. They do not feel current's presence in the wire,

because electric potential is this magical physical quantity that isn't measurable by its absolute values, but only as changing quantity. It means that electrical potential matters only in its changing quality but not by itself. Sparrow sits on wire without knowing that there in the wire is electrical potential present, because no physical equipment may measure it as some absolute quantity. In our case sparrow itself is this measuring instrument that can't fix electrical potential's presence in the wire. This is law of physics, and sparrow simply confirms this physical law, due to not knowing and not feeling whatever about current in the wire.

We considered picture about sparrows on electric wires with some intention. Because just electrical potential was first physical quantity behind what gauge principle was discovered. The discoverer was German mathematical Hermann Weyl (1885-1955), firstly in 1918: after James Clerk Maxwell invented his famous equations of electromagnetic field, Weyl tried to introduce gauge freedom in them, but didn't at first succeed because applied his invention in somewhat wrong way: the thing was too new(see (3), pages 451-452) . Maybe first man who learned how to use gauge freedom properly was Erwin Schrödinger (1887-1961) who applied this principle getting quantization of states of quantum particle. Further physicists learned how gauge freedom works in Maxwell equations too, i.e., they corrected the error made by Hermann Weyl, but it was crucial that gauge principle was discovered just there where without it didn't doesn't work anything at all. Yes, quantum mechanics is subject completely to gauge freedom, because gauge freedom as if switches on quantization of all quantized quantities in quantum mechanics. But completely the role of gauge freedom was understood only in the fifties when so called Yang-Mills quantum field theory appeared, which gave general pattern how to generalize gauge freedom on other forces of nature than simple light (2; 4; 5; 6). After this physicists started better to understand what actually did E.Schrödinger and H.Weyl before.

In work (7) we discuss how gauge freedom switches on all on quantum physics level, in book of K. Huang (2) is shown how gauge freedom turned on light, and further, all fields of forces of nature in similar way. The general principle in all this is gauge freedom.

How gauge freedom should work in order to give measure of value of money?

In order to try to find way for applying gauge freedom to money, let us start with physics. To describe physical system in most general way, we would start with writing down quantity called action by specifying Lagrangian which would be some generalization of energy of the system. As Landau shows in (8), just Lagrangian is the function of the system that is defined up to the changes in the system notwithstanding its absolute values. When we come to action we receive already actual, measurable values of the physical system. We have as if two levels, level of measurable quantities, and quantities that are defined up to gauge freedom. But notion itself 'gauge freedom' we use when gauge principle starts to work: gauging condition, i.e., changing of the unfixed quantity or quantities forces the system to receive form of symmetry which may cause part of solutions of the system arrive as if turned on due to this symmetry, part of them as if dejected by the same freedom.

How it would work in case of money? We must leave money as changeable value that is not fixed in any other way than in form of its change. We must get action from this gaugable quantity that is already observable quantity. In case of economical system, we must think as if reversely: we must get action from correctly gauged money. We are gauging money as if by hand and as an effect we should receive action, i.e., result of economical activity.

How to gauge money, how to guess right role, what in case on nature occurs automatically, i.e., nature serves its turn correctly always? We already know what we receive when money doesn't gauge, i.e., it is inflexible. We must learn the rules of the system, when we change money's level. We may find these rules experimentally.

Actually the problem turns around one simple question, how to lower the "price" of the money, because how to rise it we already know by using "law of greed or effective business". By the change of the value of money by lowering it we must learn some rule of balance, which would give us correct way how to make changes and in the same time how to maintain effectiveness of the action, i.e., how not to loose in these changes but get profitable outcome. The principle behind this should be simple sufficiently: we should be profitable in long terms, learning to be losers for shorter terms.

But this all we speak as if not having benefits of real gauge freedom without global system at work. How to let it be switched on actually that at least to some limit would imitate that what goes on in the nature? Simplest way would be to have some supervising power of all the system. In physics this becomes possible solving the problem in general, by quantum mechanics. In economical situation we should have have some global functionality in our action coordination. One way is to suggest all economical system being supervised by some monster robot. But it is not maybe necessary: maybe it suffices to have only some global parameters to know or to control or to let them work automatically, which would give feedback in our eventual action controller that would give way to play gauging in controllable direction.

Speaking of freedoms in the value on money one would say that economical systems already are doing this, i.e., all freedoms already are at work, and stock exchange activities are playing the role of what could be called forced gauge freedom. The money is already gauged sufficiently, some people would argue. But here is just crucial point where we may find out where we gauge freedom actually have, and where not yet. We argue, that this freedom must be switched maximally, or even totally. If it is not so, gauge symmetry wouldn't work at all. Actually, we even do not know what this freedom should give, because we haven't not yet seen it at work at all.

Do we want to know how far we are from gauged money?

Today main financial problem arises do to credits. Physicist like me who doesn't know much of economics and banking affair would think that changing credit conditions not only in one direction but in both would be signal that money holder wants his money to start to work: if he knows only one direction, and this direction doesn't work any more, money holder

should come to correct conclusion that he is put under blow to loose control over his money and to loose his money at all. This is only one indication. Actually, what should be done is to start modelling with maximal possible freedoms of money today, or, more radical way, to invent new mechanisms of value gauging in commonwealth. Maybe this way would say that this is the end of the notion "money" too. That we do not need money as mediator in the commonwealth at all. That we do need completely new mechanism of regulation of values of goods. But this already would be another story.

References

1. **Zeps, Dainis.** *World's Economy: what is money. Physicists approach to tendencies in world's economy.* Riga : LU MII, 2009. internet publication.
2. **Huang, Kerson.** *Fundamental Forces of Nature. The Story of Gauge Fields.* Singapore : World Scientific, 2007.
3. **Penrose, Roger.** *The Road to Reality. A Complete Guide to the Laws of the Universe.* New Yourk : Vintage Books, 2007.
4. **Huang, Kerson.** *Quarks, Leptons and Gauge Fields.* Singapore : Worlds Scientific Publishing Co Pte. Ltd, 1982.
5. **Bleecker, David.** *Gauge Theory and Variational Principles.* Mineola, NY : Dover Publications, Inc., 1981.
6. **Marathe, K.B. and Martucci, G.** *The Mathematical Foundations of Gauge Theories.* Amsterdam : North Holland, 1992.
7. **Zeps, Dainis.** *Mathematics as Reference System of Life.* Riga : Internet publication, 2009.
8. **Landau, L.D. un E.M., Lifshitz.** *Mechanics, in Russian.* M : Gosizd. fiz.mat.lit., 1958.