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Quantum Economics

Summary: The globalization is breaking-down the idea of national state, which was the base for the development of economic theory which is dominant today. Global economic crisis puts emphasis on limited possibilities of national governments in solving economic problems and general problems of society. Does it also mean that globalization and global economic crisis points out the need to think about new economic theory and new understanding of economics? In this paper I will argue that globalization reveals the need to change dominant economic paradigm – from traditional economic theory (mainstream) with macroeconomic stability as the goal of economic policy, to the “quantum economics“, which is based on “economic quantum” and immanent to the increase of wealth (material and non-material) of every individual in society and promoting set of values immanent to the wealth increase as the goal of economic policy. Practically the question is how we can use global market for our development!

Key words: Economic quantum, An individual, Innovation, Globalization, Development.

JEL: A11, A12, F01, N00, O10, O30.

1. The Idea of the Paper

Did the global economic crisis stress out the need to think about new economic theory, new understanding of economics? Did the global economic crisis point out the fact that national governments have limited possibilities to solve many problems in their economy and their society? Why is the number of member countries in “The Board of Directors of the World Economy“ increasing – first it was G-7, then G-8, and now G-20, along with growing aspirations to the “global government“? Does the development of technology, especially new communication technology, make world’s economy “global feudal economy“? If these are some of the vital questions; if this is the reality in which we live, should we, as economists, be enslaved by the books, the ideas or the mysteries from the past or should we find the way out of such ideology through the new ideas?

In the paper, I want to emphasize the need to think about the change of paradigm – from the one which treats macroeconomic stability as the goal of economic policy, to the one which considers that main goal of economic policy is to increase individual wealth (understood as material and non-material wealth) and to develop the system of values immanent to the wealth-increase. This new proposed individual-wealth-increase paradigm is related to the development based on economic quantum, and as such, it is the first step to establish quantum economics. In the more general terms, the question is whether we can explain today’s economic reality by existing theory.

2. Global Economy – The Need for New Economic Theory

Financial crisis has shown that contemporary main-stream theory is not adequate for practical life. The economic crisis made the problems visible and easier to understand, and these problems are treated as extremes, irregularities within the existing economic paradigm. Should we wonder whether these are the couriers of some new economic paradigm? Or is it just an expression of the need for one completely new view on the world and the new view on economic dimension of that world? In my opinion, the new economic paradigm is being born, through scientific revolution, as Thomas Kuhn (1999) explains it, in economics and not only economics.

Is the old economic paradigm dying? In other words, does the change of conditions which brought to the development of global economy, endanger contemporary economic theory created in completely different environment?

From the perspective of dominant economic theory, what is endangered by the global economy? What new elements global economy is bringing into existing paradigm? There are two new elements: **the chance (as the probability of occurrence)** and **uncertainty**.

If we go back to mechanistic paradigm, we can make analogy with Isaac Newton (1995) mechanics of celestial bodies. Thus, consumers can represent planets and Sun; self-interest can be considered as the gravity; and general equilibrium of economic forces, i.e. prices, consumers, and quantity can be compared to planets' movements within the Solar system. Mechanistic approach became the base of economic theory. (Ante Pulić 1990)

According to mechanistic paradigm, economics of general equilibrium is one of the basic pillars of classical economics. The notion of equilibrium in economics implies that all economic actors, on the production and on the consumption markets, are in completely balanced position. It is the state of general fairness, where all actors are getting what belong to them according to the "invisible hand" principle. It is the state of the market when supply equals demand; all goods are sold on time, as Marx said; salaries are harmonized with the income of other production factors; labor supply and labor demand are equal; working hours are adjusted, etc. Theoretical model of general equilibrium can be identified with the dominant goal of economic policy today – macroeconomic stability. As general equilibrium is the dreaming ideal of all economists, even the famous ones as Smith, Ricardo, Keynes, Marx, etc, macroeconomic stability is the goal of economic policy of each government in contemporary world.

"The ideas of the economists who died very long ago are managing our practical behavior now" – this thought of John M. Keynes (1965) well describe the situation we are facing in this crisis.

But, in theoretical context, model of general equilibrium was challenged a while ago.¹ There are many reasons that question this model.

The first one is **information!** In economic model (that explains the behavior of economic actors) information are very important element and their importance is growing. Do

¹ In the discussion with Schumpeter Friedrich Hayek (2002, 2005) is attacking his quantitative approach "When an economist, such as Professor Schumpeter easily get trapped by ambiguous term "information" cannot be considered as simple mistake... It is the warning that there is something fundamentally wrong in the approach which ignores the essential part of the phenomenon we are discussing – and that is the imperfection of human knowledge."

all market participants have the same information? Or can we say that the information are unevenly (non-linearly) distributed and we get into the problem of information asymmetry? Asymmetric information problem imposes doubts into the concept of equilibrium. Hayek's thesis on uneven and dispersed information – restrained individual knowledge is important here.

Economic behavior depends, not only on capital, but also on **the ideas in economics**. This brings us to an individual – the person and personal qualities of the human being. If this is valid, does it endanger the theory of production based on the assumption of unlimited substitution of production factors? Can we easily replace the human factor of production – individuals, whose ideas are moving forward?

As I already said above, the global economy brings new elements into economic theory – **the chance (as the probability of occurrence) and uncertainty**. Basic conceptual framework of classical economics is founded on determinable results with known parameters. Economic actors reach the equilibrium by following their own interests. However, in the global economy, this interdependence doesn't represent the regularity, which can be described by the rule, but more often is the deviation from the rule.² If reaching the optimum is a matter of pure chance, then the final outcome cannot be known in advance. Pulic says that in the system where the chance (as the probability of occurrence of certain outcome) is one of the parameters in the model which describes the system, the final outcome cannot be determined in advance.

The optimum theory doesn't count for uncertainty. The development of the theory of the second best solution in 1960's was also an attempt to bring economic theory closer to the reality. According to that theory, in the real imperfect world, it is impossible to maintain stable deviation between the existing state of the system and potential optimum (achieved through competition) and to reach the equilibrium. But, approaching the optimum can often mean that you are more distant from it in the real world, because it is very difficult to estimate how the competitors will react to the activities aimed to bring the national economy closer to optimum. All of this makes us conclude that the optimum theory, as one of the contributions of classical economic theory to the science of economics is endangered by Heisenberg "indeterminacy principle". This imposes doubt to the principle of rational behavior.³

There are many more examples in favor of the need to leave old mechanistic paradigm and change dominant approach in economics. Analysis of Smith's work shows that he didn't write about the market too much – it is mentioned in just two titles of his most famous book. Adam Smith (1998) writes about local markets and economics at the time when "people were born, raised and died at the same place". Smith also wrote: "The man is

² Frank Knight (1921), the founder of Chicago School of Economics, a man worth of respect, not only by his economic work, but for the ideological foundation of Chicago School from the early 1920s, attempted to introduce uncertainty and risk into microeconomic models. He thought that risk can be expressed through probability of occurrence and it can be measured by the amount of money needed for insurance from that risk. The rest of the risk is beard by entrepreneurs and that's why they have right to earn the profit.

³ "The view of contemporary economic theory, within the framework of current economic research, is no longer based on the predictable solutions, which would be the result of rational behavior. The probability of occurrence if the most important element of economic environment, which bring us to the high level of uncertainty no matter whether economic actors behave rationally or not." (Daniel Fusfeld 1980).

the most complicated “cargo” for transport”. At that time the world was filled with obstacles – economic, political and physical, Smith didn’t pay attention to trade unions and their influence in the economy.

David Ricardo (1953) based his theory of competitive advantages on the idea of marriage between national state and national economy. Keynes did the similar thing, with one difference – in his work the state interferes into economy, and thus endangers the “invisible hand” principle. Keynes “visible hand of state” is the strong theoretical basis for economic policies of many governments today. Keynes theory is in accordance with the interests of bureaucracy, which also have political power (the power of making important decisions that influence economy).

But, Keynes was thinking within the boundaries of closed economy; his work doesn’t go beyond the model of closed economy. He doesn’t speak about the model in which the economy is closely related to the outside’s world (open-economy model). Many facts and features of contemporary reality deny Keynes work. Thus, opposite to his claim that any positive economic trend is followed by the growth of employment, experience of several last decades show that when the employment is going up, the capital markets is going down. Today, the investors are aware that the high level of employment may be the sign of low productivity level, and as such, it can influence lower profitability. The fact that must not be forgotten is that profit is the crucial motive for trading securities. Keynes made an attack to classical and neoclassical school of economics, claiming that the supply and the demand (the market) cannot reach long-term equilibrium. In order to reach the equilibrium, the state (the government) should index the consumption, in order to compensate for the shortage of consumption in closed system of national economy. That was the starting point of Keynes theory: the demand is creating the supply, which was opposite from Say’s theory (Say was French economist, known as the French Adam Smith). Say was claiming that the supply is creating the demand, i.e. that any good produced, will find someone to buy it.

Ricardo’s world, as well as the world in the time of Keynes or any other economist in 18th, 19th and 20th century was the world of the nation-state. The time of imperialism (big empires) was gone, and the era of nationalism has come, with the protectionism as the keystone of economic policy. How to protect domestic economy from the outsiders’ world – that is the crucial question of economic policies today?

Does the global economy change something in the approach used by national governments in last three centuries?

Does the experience practically validate the philosophy of the dominant economic model, founded on the linear, smooth and one-way directed economic relations? Closed economy implies the linearity of economic relations. This can be compared to the fact that we cannot expect big waves on the lake – big waves as the metaphor for the non-linear economic relation.

What about the ocean waves? What about the open sea waves? Aren’t the waves the association for the global economy? Can we understand these big waves the chaos and non-linearity, as the development in leaps?

3. Quantum Economics – Theoretical Foundation of the Global Economy?

From theoretical point of view, the global economy has all characteristics important to understand the need to change dominant approach in economics and economic policies today.

If the mechanistic paradigm was the base for the model of national economy developed in last three centuries, can we use it to answer many challenges of global economy today? Did the global economic crisis open this and many similar questions? Is it possible to solve the problem of the crisis on the national economy level? Why have G-7 turned into, first, G-8, and now G-20? Where does the need to change the role of IMF come from?

The discoveries in physics, which brought to the change of the dominant paradigm, cannot stay without influence on economics, both as theory and practice.

It is extremely important to point out the impact of the discoveries in the quantum physics on economic theory. Before the quantum theory, the physicists believed that the analysis of atoms will show rigid, solid, non-divisible particles; rigid and static substance. Something similar to the substance we see around us, but now projected inside the atom. The atom is the copy of the outside world, the world we feel by our senses, projected into the micro-world. However, it happened to be the false assumption! The atom is the divisible particle – the space within which smaller particles, the electrons are spinning around the nucleus, consisted of protons and neutrons. The later discoveries showed that sub-atomic particles appear in two forms – as a particle and as a wave.⁴

This means that the substance is not tied to one place, to one location. The substance is in motion. The place that the substance will take in space is not “apriori” defined. Every position in space can be achieved with certain probability. The cause-consequence principle, i.e. the philosophy of determinism is not applicable. It is possible to estimate the probability of occurrence of certain position. In order to explain this I’ll quote Fritjof Capra: “on sub-atomic level, solid bodies, which are in the focus of analysis of classical physics, are dissolved in the probability patterns“. For the first time in history, the science faces the fact that sub-atomic particles are not really the objects, but the **relations** between the objects, the connection between objects.

All of the above change the picture of an atom, analog to the Solar system and planets. That’s why Niels Bohr said that the quantum theory is not related to certainty (determinism) but to possibilities, potentials.

The next step in the development of the quantum theory was made by Werner Heisenberg (1998), who claims that science is subjective, meaning that the result of every experiment depend on the relation between the scientist and the experiment. Introduction of this

⁴ In order to understand this bilateralism Niels Bohr introduced and explained his concept of “complementarity” in his famous 1927 Como Lecture reproduced in Niels Bohr (1934). According to the notion of **complementarities** there are pair of values, which are necessary to completely describe the atom (the wave and the particle). The notions of the wave and the particle are two complementary descriptions of the same reality. It is very difficult to understand many notions from the quantum physics not only to non-physicists. On the language problems see more in the Heisenberg’s article “The knowledge and the reality in modern physics“ contained in his book *Physics and Philosophy*: “The notion of complementarities introduced into the science of physics by Niels Bohr encouraged physicists to rather use the terms in bilateral sense than in single, précised meaning, which means that they use traditional phrases with not such a clear meaning.“ (p. 145)

subjectivity element creates famous Heisenberg's "indeterminacy relation".⁵ The indeterminacy principle is completely opposite from the principle of causality (determinism). On the other side, the Heisenberg's shift from the objects to the relations had significant influence on the way of thinking. For the first time in the history of science, the quantum theory has established the unity between the subject and the object (the experiment and the scientist), people and nature.⁶

In addition to this, the quantum theory has shown that sub-atomic particles are not the substance in solid form – they are not micro-grains of the substance, but they are the **probability patterns**, "expected tendencies", possibilities, potentials, as Aristotle used to say. That's why the substance is not considered as something stationary, but as something mobile, dynamic, perpetually in movement. This means that there are no static structures in the nature, but only stable dynamic equilibriums. Einstein's discovery that the mass is the form of energy and that the energy is the mass, interrupted attempts of scientist, which dated from the ancient time of Epicure, to discover basic structural elements of particles, as these are now considered to be the rays of energy. The particle is the ray of energy, not the dead grain of substance! "The particles are the dynamic patterns, which unites the time and the space dimensions. Their space dimension appears through the existence of the body mass, while the time dimension is expressed through processes. The substance and the forms of its appearance cannot be divided, they are just the different forms of the same space-time reality!" (Pulić 1990, p. 48)

Due to the development of the quantum theory, the science of physics establishes the new concept, which starts from the organic, systematic, or, now popularly named, holistic approach. As I already said, in this concept, the world is not understood as machine, composed from many different parts, but as the dynamic unity. Similarly, the principle of linearity, followed in economics, is abandoned (the totality is the composition which can be divided into the containing parts, that have the characteristics of the totality). The principle of non-linearity is introduced. The starting point of this principle is that the totality is exceeding the sum of the containing parts. That's why the features of the quantum theory, unlike the traditional concepts based on the causality and simplicity, are: self-organization, complexity, synergy and chaotic structure!

All of the above indicate the need to change the economic paradigm, which should rely on several principles: (i) openness (free flow of information); (ii) the existence of disequilibrium (the form of organization which resists entropy); (iii) self-confirmation (the possibility to reproduce the elements of system). This paper have no intention to discuss the new economic paradigm, but just to point out that changes in the theoretical science, especially physics, necessarily bring changes in economic paradigm.

⁵ "In Copenhagen at the beginning of 1927 Heisenberg established the foundation of his indeterminacy principle according to which there is no chance that we can precisely determine the position and the speed of an particle or a ray of energy and the exact moment of occurrence of an event" (Pierre Radvani and Monique Bordry 1997, p. 98).

⁶ This is one of the unions between the physics and Eastern mysticism, which is in focus of Fritjof Capra's (2004) book "The Tao of Physics". "The most important feature of Eastern mysticism is the thought on unity and mutual interdependence of everything, which occurs as the different form of essential unity. All things are seen as interdependent and non-divisible part of the unity of Universe, as the different manifestation of the same final reality." (p. 113).

Is the global economic crisis and global economy just the proof that we need new, different understanding of economics? Can we explain some facts from the real life with the existing theoretical approach to economics? Can we look at those phenomena from practice as on the current deviation from the prevailing economic paradigm, or as on the announcement of the new paradigm?

I accept the facts of the life: global economy is the reality, not some kind of theoretical dream. Many economic theories were created in completely different conditions in the past. They were created in the framework of the nation-state. Today, an economy is not bounded inside national borders; the world is not just the composition of completely separated and independent nation-states, although this model still prevails. Unlike it, the world is the complexity of interdependent individuals, nations and religions.

The second element of the old paradigm is the belief in causality principle and cause-consequence mechanism. If interest rates go down, it will enhance the economy, as the employers can borrow more money to invest in new projects. When the Central bank increases money supply, interest rates are falling down and stimulate the economy. This causality is the foundation of many economic policies, and the justification of political interference into economic activities. What is going on when the borders are abolished, as in the global economy today?

For example, if you increase the interest rates, will it attract the capital from “the rest of the world”? (Kenichi Ohmae 2008 said this has happened in US after Greenspen increased interest rates at the time of Clinton Presidency.) This migration of money into areas with higher interest rates is influenced by the fact that globally population is getting old and that pension funds are “full” of money, which don’t want to invest in high-risk instruments. In the borderless world the surplus of money supply if issued by Central bank can leave the country, if there are no attractive investment opportunities (Slavoj Žižek 2008).

Well developed information systems and fast transfer of information change the importance of stocks in business policy of the company. The claim that the increase of the interest rates will influence companies to accumulate the stocks is not longer being confirmed in practice. It is realized that money i.e. cash is the best form of keeping stocks.

This is also related to new financial instruments, which strengthen the relations between the world’s financial markets. Can we say that in these conditions national governments are free to make decision on financial policy? Not only domestic, but first of all foreign subject are potential buyers of government bonds and other public debt instruments.

National governments also don’t have complete freedom to make fiscal policy decisions. The effects of government measures depend on the measures of other governments, companies, and consumers all around the world. In such interdependent world the money is moving from one part of the world to another, depending on the level of return – earnings yield. In this moment it is very complicated to think about some kind of supervision, which would control global super-liquidity and the influence of political parameters in certain countries on global super-liquidity.

The dominant approach in economic theory and practice today still rely on the closed model of the nation-state. Keynes is the father of this paradigm. Many think that the global crisis re-discovered Keynes and we should clean the dust from his books. However, it must not be forgotten that the “general” economic theory of Keynes is the response on the crisis from 1929. The key difference is that Keynes is looking the solution within the closed

model, not within the model closely related to outside's world, as today's world. Keynes wrote about the development based on the internal market of the nation state, i.e. he tries to define the rules of development on the internal market.⁷

Keynes work continues the tradition of economic theories that emphasize the importance of labor and employment. Smith was the one who introduced the wealth in economics as something positive, optimistic, while Keynes focused on the unemployment as the most negative phenomenon from the real life. The importance of unemployment in economics is indisputable. But, the practice of global economy shows that in some areas the employment grows, while the securities market is falling. As I already stated the investors may conclude that high employment implies low productivity level that can reduce their potential profits.

Many other relations change if the country bases its economic development on the **world's market**, not on the internal market. In the internal market model, money flows can be controlled and predicted less or more certainly. But, when the economy develops in the global environment with mutual international relations, money can get in or out the country easily and you cannot control or predict it. **Uncertainty is much higher than predictability.** Technology changed the world and thus it changed the economy. For example, in time of Ricardo, the carrier pigeon was very important mean to transfer information. Can the same economic technology be used to explain economic behavior of individuals and companies at the time of internet?

Technology has changed the world and the perception of the world. Sometimes US was very far away, it was the "end of the world". Different form of communication existed back then – but it was slow. The speed of communication technologies is changing everything. Ohmae says that the technology is changing the geopolitical reality by turning the old nation-states into anachronisms. Don't we take the information as one of the crucial reasons for the crush of Soviet Empire? Due to modern technologies information has found different ways to get through the walls of control in Soviet Union. Under the attack of information the closed system is forced to open and disappear.

Technology made the world **complex and chaotic**. The features of the substance discovered through quantum physics can be recognized as the practical manifestation of the global economy. There are many parallels between the world of complexity and the world of the global economy. The global economy has many variables that influence one another. It is the system which is naturally dynamic, but not always predictable. Small change in one variable can cause large and unexplainable changes on some other place (the butterfly effect). This interdependence and hardly visible influence endanger and destroy the myth of equilibrium (balance). The prevailing approach in current economic theory says that economic systems are going toward equilibriums, while the theory of complex system proves that classical "equilibrium" is just one of the "points of attraction". This theory makes difference between many other forms of attractions, which are very complicated to be understood.

As the science of physics before Heisenberg (1998) and Bohr (1934) didn't understand complex systems, the complex systems, as the practical manifestation of the global economy are not understood in economics. This non-understanding of the new phenomenon of the global economy requires the new economic theory, the new view on the eco-

⁷ It is interesting that the same logic is underlying the measures recommended by IMF today: strengthening so called internal development, which is interpreted as the confirmation of protectionism by many.

nomics, the new economic paradigm. Can the science of physics be of any help there? Can the experience of physics can be helpful?

The discoveries of the quantum physics did not ignore Newton (1995) and his mechanistic paradigm. In conditions in which it was created, Newton's theory is still valid. However, the conditions have changed. Newton's physics can only explain the fragments of the real world. This means that the traditional classical economics, created and married to the nation-state, is valid today in areas where the nation-state still functions. But the global economy is overwhelming the national economies and it requires the new economic theory, adapted to it.

The global economy has to be considered as the totality, as the whole. It is not just the simple sum of all 200 economies, joined in a pile. It is the unity with the interdependencies within it. The truth is that the model that can describe it still non-existing. But it is expected that the further development of global economy will influence the development of that new economic theory.

If we use the experience of physics, the analogy would be quantum economics⁸ – where the based on openness, complexity, chaotic structure, indeterminacies, uncertainty, and unpredictability?

4. Instead of Conclusion

The economic crises pointed out the need to develop new economic theory – the theory which can be used to explain the behavior in the global economy. In practical terms, it is one completely new question: how can we use the global market for our development? How can we be the part of that global network, whose behavior is still far from our understanding? This crisis has shown that there are always some creative individuals in the world who easily and fast adapt to the new conditions and adapt those conditions to themselves. On the other side, there are so called “practitioners”, who are stubborn and look for the way to solve the crisis by thinking within the framework which brought the world into the crisis. This is the proof that “practitioners” are just “the slaves of economic theoreticians who survived”.

Has this crisis been the warning that we have to be more creative, and less practical? That creativity should be the result of energy bundles emitted by the economic quantum – the head of the creative individual! Of course, the time is needed in order to shape the theory of economic quantum in the complete quantum economic theory!

This paper has no intentions to contribute to the development of that theory. The goal of the paper was to point out the importance of some elements of economic reality, revealed by the economic crisis, whose explanation requires the development of new economic paradigm. The starting point of this paradigm will also be the markets, i.e. the Hayek's catallaxy.

⁸ This phrase is taken from Ohmae, who used it in his discussion on global economy. Kenichi Ohmae is a physicist.

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