

# Turbulence and Entropy in Social and Economic Systems

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**Abstract**— The current socio-economic crisis actualizes the problem of searching for and applying theories that can explain a way to develop new models describing a changing of socio-economic reality. Is possible to see that in economic systems that are in a state of turbulence, production and expansion of entropy occurs, since weakened elements of the system are not capable of suppressing it to the proper degree. About the scientific debate, is important to underline that views of economist scholars on the problem of entropy are extremely different; indeed, its definition are determined by the direction of research and the tools used.

The aim of the research is to consider the concepts of analysis and evaluation of turbulent states and entropy in socio-economic systems; the study conducted a review and a comparative analysis of main theories that talk about this topic in the framework of the synergistic and political economy approaches. Moreover, the essay analyses the nature of turbulence and entropy in socio-economic systems is. The main methodological approaches are revealed in the framework of synergetic and political economic research aimed at the analysis and assessment of turbulent states and entropy in socio-economic systems.

**Keywords**— *synergetics, entropy, turbulence, economic analysis*

## I. INTRODUCTION

The phenomenon of turbulence was discovered by Reynolds in 1883; he was making a physics research about hydrodynamics, but today the word turbulence is used also to indicate a specific state of social and economic system [1]. Economic turbulence is such economic state in which main economic indexes are not stable, for this reason a system is living a phase of turbulence when it doesn't have an equilibrium. Moreover, when the turbulence is irreversible, so the economic system is not able to come back to the previous state, is possible to affirm that an economic cycle has just concluded.

## II. METHODOLOGY

Real dynamics of macroeconomic development testifies that it passes through a turbulent spiral; this thesis allows us to conclude that changes observed in an economic system are

irreversible, as well as the impossibility of restoring previous dynamic states. According to L. Vasilyeva and N. Tymoshenko, the turbulent state of modern economic systems makes it difficult to build forecasts, introducing unpredictability and chaos in the economic development process [2]. Moreover, the irreversibility of the changes and the impossibility of bringing the System back to the previous state give rise to a phenomenon known as hysteresis in complex dynamic systems. This phenomenon appears because complex dynamical systems have a not linear dynamics; indeed, if an event leads to a transition of the dynamical system in a determined state, that does not mean that we can bring the system back to the starting point, eliminating the cause of the event that causes the transition. Therefore, it is possible to observe that the phenomenon of hysteresis for example when the inflation grows up because of an excess of money; anyway, a consequently effective reduction of supply of money doesn't mean an instantaneous recovery of the macroeconomic system. In all cases, this particular and easy example of hysteresis cannot explain the complexity of processes that, all together, create the inflation and they influence its increase, but in any case, it shows the consistency of the hypothesis that the economic system can be exposed to this phenomenon.

G. Zhuravlyova, making an empirical analysis of turbulence in the modern economy, affirms that there are four factors that can create a turbulent state of world economy: chaos in financial markets, because of the more chances of being able to move capital from one country to another in a climate of liberalization; tightening of wars for the control of resources; social and ecological crisis; global migration flows [3].

The cyclical nature of the development of the economic system is largely due to a change in technological structures. However, the change in technological structures does not always lead to a real change in economic performance [4].

According to S. Afontsev, the causes of economic fluctuations are extremely different and depend both on the specific period and on the indicators studied; therefore, the

equilibrium of the economic system should be understood as its position on a certain attractor, reflected in the cyclical development of the system [5].

The financial turbulence is one of main practical examples of this kind of phenomenon and it taking much more importance also because it influences the real economy. The European crisis of 2008 can shows how the financial market had irreversible modified the real economy and economic policies of Governments [6]. Anyway, the turbulence can be the result of an important change in the organization of an enterprise; for example, trying to develop a firm the governance decides to change radically the structure of the enterprise, this will automatically generate a period of turbulence in which the enterprise has to assimilate the new organization [7]. Other factors that can create a period of turbulence, especially since the 60' years, are visible in the Western Country and they are: the absence on the control in the supply-side and on the growth of the supply of labour [8]. The unpredictability of development forces researchers to resort to non-traditional methods of forecasting and modeling economic dynamics. For example, the Australian studies J. Jaaskela and M. Kulish, conducting a macroeconomic analysis of open economies, focus on the effect of the butterfly effect. The essence of this phenomenon is influenced by the dynamics of large open economies, as well as by the overall dynamics of the global economic system, increasing the power of uncertainty in world economic development. The induction of uncertainty, according to the opinion of J. Jaaskela and M. Kulish, arises as certain of the non-observance of Taylor's dominance in the conduct of foreign monetary policy [9].

### III. TURBULENCE IN THE MODERN CAPITALISTIC SYSTEM

One of main problems that characterize the modern capitalistic system is the dissipation of energy, that violate the reach of a general equilibrium because of the entropy that work inside capitalism, as well as on every thermodynamic system. According to the second principle of thermodynamics, economic resources are not infinite and, as a rule, end in the long term. Moreover, every transformation process (or of production) requires so much energy, that transforms an amount of resources in a final good; the problem is that a part of energy is lost during the working phase, even if it was used during the production process. As J. Rifkin proposed that more than a social organism develops himself becoming more complex, it requires more energy to maintain its efficiency as well as also entropy increases. In reality, neither capitalism nor socialism can accept the harsh truth of the "real world" imposed on society and nature by the first and second law of thermodynamics" [10].

The fact that entropy does not allow capitalism to achieve sustainable growth opens the debate on the irreversible collapse of modern neoliberal capitalism, which is based on consumption and the constant growth of production. Currently, various alternative theories support the above thesis, indeed all the relatively young theories, which are in part related to the classic critique of capitalism, go back to the Marxist theory of socialism. These concepts of the 21st

century laid the foundations for the modern critique of current capitalist theory, particularly as regards the practical application of the concepts of neoliberal capitalism in the late 1990s in the United States and Western Europe.

We can distinguish the fundamental differences between modern theories aimed at criticizing capitalism and their predecessors in the face of classical criticism of capitalism.

The classic criticism of Marx's capitalism explains that the capitalist system can not have a future, since it seeks to destroy all resources, beginning with the destruction of the surrounding nature. Studying the analysis of Marxist theory, K. Saito emphasizes that for Marx, as for Engels, the true will of the capitalists to increase profits and, consequently, to production, will lead the capitalist system to the destruction of nature and, consequently, economic resources. For this reason, according to classical criticism, capitalism in any form can not guarantee a future for society, while acting as the main reason for the destruction of human nature

On the other hand, modern criticism of capitalism believes that capitalism is a crisis system that needs modification of some parts to ensure the future global development of all mankind. Analyzing the theory of H. Feldner and F. Vigi, we come to the conclusion that one of the ways to ensure stability in capitalism is technological development and innovation. However, these phenomena should be environmentally sustainable and accessible to a wide range of consumers, without any barriers to entry to the market [11].

Moreover, the failure of capitalism, connected with the concept of entropy, finds an ally in mathematics. A person who consumes energy incorrectly, whether it is renewable or non-renewable energy, leads to an increase in disorder and entropy, for example, to higher pollution of the environment or the destruction of other economic resources.

One of the most important factors that changed capitalism, especially after the end of World War II, was another way to innovate and search for new technologies. Indeed, if in the 1920s and 1930s technical progress was focused on the development of industrial production methods, then in the period from the 60s to the 70s of the 20th century, we can talk about post-industrial technological development. In accordance with Bell's theory, it can be said that the third industrial revolution (or post-industrial revolution) began in the 1970s, and more specifically in 1973, with the onset of the first global oil crisis, which actualized the problem of using natural resources and excessive depletion of hydrocarbon raw materials. That is why a new industrial revolution, based on information and communication technologies, was launched at that time [12].

Any economic process that produces material goods and uses natural resources, reduces the availability of energy in the future and, therefore, reduces the future ability to produce new products. Thus, it can be concluded that, according to Georgescu's theory, the concept of sustainable economic growth can lead to even greater consumption, since it inspires confidence in the existing consumer model. Instead, it would be more productive to talk about the economic balance resulting from the rationalization of the use of natural

resources and the search for alternative energy sources that could ensure the development of the economy in the medium and long term [13].

#### IV. HOW TO PREVENT TURBULENCE

First of all, is important to underline that there is not a mode to prevent the economic turbulence, considering that there are too many generic factors that can start a turbulent process. For this reason, main actors that can be affected by turbulence (like Government, customers, small-medium enterprises and big companies) can only prevent the possible indesiderable effect of turbulence as well as they can control the entropic process in economy. It is clear that depending of which actor is considered, there are different plans and solutions.

For example, small-medium enterprises has to use the positive moment of entropy in order to develop themselves and to increase their volume of affairs; to do it there are only two possibilities. The first is to increase their innovation and their Research&Development sector; the second is to reduce those “bad” factors that doesn’t permit the maximization of profits and reduction of income. Vice versa, when the economy is living a negative period of turbulence, SMEs has to survive trying to not reduce their quantity of investment. The gravest problem that afflict small and medium enterprises during a turbulence is the problem of liquidity, indeed SMEs don’t have enough liquidity to pay most impellent expenditure, as well as wages and resources. At the same time, small and medium enterprises are not payed totally, when they have just finished to sell a good or a service; very often happens that customers of SMEs can pay only a part, expanding payments in different payments. Small and Medium enterprises do not have enough reserves to pay their expenditure as well as they usually don’t receive enough help from the financial system; the result is that happens that SMEs close because they don’t hae liquidity to pay their expenditure even if they have enough credits to continue their production.

Looking at decisions of Government, during a negative period of turbulence, the only solution that can guarantee the end of this period is a support to the national economy that can guarantee, in a future perspective, a new phase of development. Government has to invest in the future of its nation means that looking at customers it doesn’t have to increase level of tax, because it stops the urge to buy products; looking at companies, Government has also to not increase taxes and it has to create new investments. Public works are a mode to stimulate the national economy. Moreover, Government can create programmes of subsidizing to help such economic sectors that are suffering more the economic crisis.

The trade-off between private and public technology has become unstable due to the global economic crisis of 2008, part of the developed world, the ability to acquire technology, began to lose its purchasing power, but also to lose the access to new high-tech products. The modern banking and financial system has contributed to the creation of a spiral of high-tech and low-cost products to give the consumer the illusion of being able to buy more technologically advanced products. If

in the past people have been forced to buy things that are objectively beneficial for their life (such as a car or a house), but now go into debt in order to acquire the most modern TV or iPhone.

With the onset of the economic crisis, which has not yet come to an end, many economists have begun to take a critical stance regarding the current globalized neoliberal capitalist system. Critics usually turn to various theoretical approaches. Let's try to consider one of these theories, based on the use of entropy. This is Serge Latouche's "anti-growth theory".

According to S. Latouche, the economic crisis can be overcome by stopping the quantitative and qualitative increase in requirements, which are devoid of the necessary primary and without real importance to human life. This is a fundamental synthesis of Latouche's thought, published in 2007 in his work "Petit traité de la décroissance sereine". It can be argued that the anti-growth theory was born at the beginning of the last century in the form of criticism of the consumer society[14].

Latouche’s theory is strictly connected with the behave of big companies that in a period of turbulence, thinking to their own interests, they prefer to speculate instead of to observe to their social function.

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