Duality of Fluctuations in Economic Systems Development

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The paper deals with the analysis of fluctuations duality in open economic systems development. Fluctuations are often seen as deviations from the average states of the system. Fluctuations do perform a dual task in economic systems development. Firstly, fluctuations may generate a neutral background, which actuates the protective mechanisms of economic system development. Small fluctuations are leaving the system at the same level of stability due to negative feedback mechanisms. Secondly, fluctuations do create preconditions for the transition of economic system to a new level of stability. The last is promoted by incorporation of positive feedback mechanisms. It is stated in a paper that increasing returns are related to mechanisms of positive feedback – within different markets, firms, and industries. Specific economic situations are analyzed to prove the duality of fluctuations in development of real economic systems.

Keywords: economic duality, economic fluctuations, open economic systems, positive and negative feedback.

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Introduction. Interdependence and interrelationships of modern economic systems requires new methods of research. Classical economic theory with its inherent constant return to scale cannot describe the wide majority of modern production based on increasing returns. Modern economic systems have received favourable conditions for realization of natural selection potential. Temporary research methodology is also changing promoting the development of synergistic approaches. Categories of synergy, its basic ideas and methodological approaches have gradually penetrated into different areas of the economics. Also, it is important to consider the ongoing volatility of economic systems in conjunction with reproducible economic fluctuations and bifurcations, formed by different kinds of markets (goods market, capital market, labour market). All these processes are taking place in conditions of limited resources and tightening of competition.

Fluctuations are oscillations, which can be created by environment, and by the system itself. Fluctuations are often seen as deviations from the average states of the system. It is important to note that at the system rebuilding to another level of stability, it is the fluctuations that play the role of multi-variant development insurance. When the economic system is at bifurcation stage it is usually selected one or several fluctuations, which define further system development. Also, like many elements of economic system, fluctuations do showing the duality effects. The duality of fluctuations is mainly revealed in the restructuring the system and its stability insuring.

The analysis of recent research and publications. The problems of stationary systems development are analyzed and studied by many Ukrainian and foreign scientists: O. Balatskiy, M. Faber, H. Haken, L. Melnyk, I. Prigogine, R. Perman, S. Kharichkov, M. Hvesyk et al.

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However, the research of economic systems development should deepen in the direction to increase the role of fluctuations for economic system stability insuring. The researches on fluctuations are of major importance in the context of limited resources and increasing pressures on the environment.

Setting the research problem. In this paper we put the task to identify the duality of fluctuations in open economic systems development. Additionally the problem of determining the place and role of innovation in economic systems development are analyzed.

Fluctuations do perform a dual task in economic systems development. Firstly, fluctuations may generate a neutral background, which actuates the protective mechanisms of economic system development. Small fluctuations are leaving the system at the same level of stability due to negative feedback mechanisms. It should be added that sometimes not only small fluctuations, but also significant ones can't change the steady state level. Secondly, fluctuations do create preconditions for the transition of economic system to a new level of stability. The last is promoted by incorporation of positive feedback mechanism. Let's consider these situations in more detail.

The role of fluctuations in negative feedback mechanism implementation. Fluctuations can act as a neutral background, slight deviations of system parameters from their average values, which do not contribute to significant system deviations. Moreover, these individual fluctuations do push negative feedback mechanism to preserve the former steady-state parameters. Negative feedback – it is a system reaction in a form of response to the influence of the external factor. In case of negative feedback the system response action is aimed at opposite direction to direction of external action factor. In other words, the system is trying to minimize the influence of this factor, reducing or completely neutralizing the consequences of its actions and maintaining its previous state. Adaptation mechanisms do realize the functions of variation, inheritance, selection, retaining the characteristic features of the existing economic system. Thus, even large fluctuations which do not exceed a certain threshold are covered by the rest mass of the "quiet" system elements through the adaptation mechanisms and negative feedback.

The adaptation mechanisms do have a distinctive feature that neither external nor internal disturbances are not able to move the system beyond the "foreseeable channel of evolution" corridor [7], prepared by the nature for system development. Thus, possible states of the system are sufficiently foreseeable in future and the ways of its development are predictable with reasonable accuracy.

For example, given the increasing risk of external financial markets development, some national financial and economic markets can properly work, if households do trust the economic policies of their government and do not make speculative decisions. But in case the economic system is in chaotic state, a lot of 'fresh' energy and large-scale fluctuations have the ability to change the system equilibrium level [4].

The role of fluctuations in the positive feedback mechanism implementation. Fluctuations may also play a role of a new state source forming. Fluctuations can change the difference of energy potentials, due to which the system carries out an exchange with the environment. If the threshold of system sensitivity is exceeded by the impact of individual fluctuation under favourable circumstances fluctuations can shake the system and change its initial state.

Positive feedback is a system reaction to the external action. In case of positive feedback the system reaction as a response to influencing factor is directed at the same direction as the influencing impact. In other words, the system is trying to strengthen exposure of the impact

effects factor, changing its previous state (level of homeostasis) [6]. Positive feedback is the type of the mechanisms by which the system seeks to strengthen the external impact and further move away from the equilibrium state [1].

One of the examples of positive feedback in social systems is a positive feedback between population growth and technological development, which explained the observed up to the 70^{th} of the last century the hyperbolic growth of the world population. This positive feedback can be schematically described as follows: technological growth – increase the carrying capacity of the earth (the expansion of the ecological niche) – demographic growth – more people – more potential inventors – acceleration of technological growth – the accelerated growth of the bearing capacity of the earth – even more rapid population growth – rapid growth in the number of potential inventors – even faster technological growth – further acceleration of growth carrying capacity, etc. [5]. As an example we can also mention a positive feedback loop between income and consumption. The bigger the income per capita in an economy, the more people consume, therefore further increasing their income per capita, and so on. Ceteris paribus, this mechanism will continue infinitely.

In many industries, nothing succeeds like success, i.e. a successful firm makes money (output) which is partly used to improve the same reasons of its success (input factors). Costly innovations (if successful) give rise to profits which allows for further Research and Development [9].

Increasing returns are the tendency for that which is ahead to get farther ahead, for that which loses advantage to lose further advantage. The increasing returns are related to mechanisms of positive feedback – within different markets, firms, and industries. The positive feedback mechanisms do reinforce that which gains success and aggravate that which suffers loss. Additionally increasing returns do generate not equilibrium but instability, for example according to [8] "If a product or a company or a technology–one of many competing in a market–gets ahead by chance or clever strategy, increasing returns can magnify this advantage, and the product or company or technology can go on to lock in the market".

The above mentioned characteristics of specified mechanisms can provide a comparative analysis of the impact of these mechanisms on the rate of evolutionary processes. In the case of negative feedback mechanisms the external energy is used to maintain the equilibrium state of the system at the same level. In the case of positive feedback – the system is forced to bear the additional costs of its transformation (reconstruction) (Table 1).

It should be noted that for the implementation of adaptation or bifurcation mechanisms there should be a required background of endogenous and exogenous factors. According to [3] fluctuations are considered as the most probable source for the economic systems development. However close to the equilibrium point the system becomes insensitive to fluctuations (due to the realization of defence mechanisms – a negative feedback).

Accordingly, the economic system often does not detect all of its properties and development prospects. That is why the innovations are needed to "undermine the system" and ensure its progressive development. In certain cases, there is a risk that fluctuations in the form of innovation can lead to a worsening of social and economic relations; in these cases it is necessary to address carefully the potential conflicts. Due to the "innovation signals in the form of fluctuations" the economic system acquires the ability to find the possibility of non-standard transformations [2].

There are three ways to change and transform the economic system: 1) to change the energy potentials of metabolic fluxes of the system; 2) to change the information entity of a system (meaning the information code changes), and 3) to block synergies (e.g., blocking

communication channels / or relationships between the subsystems). And at the end, the fluctuation can play the role of the trigger, or the "last drop", when the system has already reached a high degree of disequilibrium and instability. Let's demonstrate this by examples of economic systems behaviour.

Table 1. The reaction of the feedback mechanisms
of enterprise in response to the resources price increase (negative fluctuation)

Feedback mechanism	Direction of the influence	Related costs
Negative feedback	Actions aimed at the preserving of the sales through: a) additional marketing and advertising; b) improvement of product quality and maintaining sales through maintaining the price level or a forced reduction in sales caused by price increase; c) preservation of prices in expectation to increase sales and preserve the overall level of sales;	a) additional costs of marketing and advertising; b) an increase in the cost of production, which, as a rule, leads to a decrease in profits; c) decrease in profit volume, which can be received from the sale of products;
Positive feedback	Refusal of earlier products production and transition to production and sale of new products	Additional costs for production modernization, the opportunity costs of production and the possible sales of earlier products

The main cause of the global economic crisis originated in 2008–2009 years was the blocking of "signal system" feedbacks, supporting safe modes of the system. The limitation of economic system before crises was secured by buying power of demand. The decreases in effective demand (in relation to economic systems) usually proceeded by rapid onset of illness (crisis). For the economy it implies a need to reduce activity through upgrading or switching to more efficient technologies, but it has not happened in a particular country (in the U.S.). And fluctuations in the mortgage sector triggered for the unfolding of the global crisis.

Conclusions. The existence of bifurcation points adds new elements to economic forecasting such as fluctuations around equilibrium or continuous approximation to the bifurcation point due to the accumulation of fluctuations.

Smooth transition from one steady state to another is impossible without the proper use of resources. It is necessary either to provide positive feedback for system elements to accumulate fluctuations and due to further synergies transform system into a new state. The second potion is to create conditions to bring the system into essential nonequilibrium state where through positive feedback and rapid accumulation fluctuations the point of bifurcation is achieved.

The smooth development is possible only within the same steady state. However it does not reject the possibility of gradual transition from one state to another and reorganization to the chosen direction (defined attractor) due to the internal resources costs.

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Дуализм флуктуаций в развитии экономических систем

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В работе анализируется значение дуальности флуктуаций в развитии открытых экономических систем. Флуктуации рассматриваются как колебания, которые могут создаваться как внешней средой, так и воспроизводиться самой системой, часто рассматриваются как отклонения от средних состояний системы. Флуктуации выполняют двойственную задачу в развитии экономических систем. Во-первых, флуктуации могут создавать нейтральный фон, который приводит в действие защитные механизмы экономической системы, оставляя систему на

том же уроне устойчивости благодаря механизмам отрицательной обратной связи и адаптации. Во-вторых, флуктуации могут создавать предпосылки для перехода на новый уровень устойчивости через включение механизмов положительной обратной связи. Важно отметить, что при перестройке системы на другой уровень устойчивости именно флуктуации выполняют роль обеспечения многовариантности развития. Когда экономическая система находится в фазе бифуркационного перехода, из большого количества флуктуаций выбирается одно или несколько состояний, которые и определяют дальнейшие пути развития социально-экономических систем.

Ключевые слова: открытые экономические системы, положительная и отрицательная обратная связь, экономический дуализм, экономические флуктуации.

Дуалізм флуктуацій в розвитку економічних систем

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У роботі аналізується значення дуальності флуктуацій у розвитку відкритих економічних систем. Під флуктуаціями розуміються коливання, які можуть створюватися як зовнішнім середовищем, так і відтворюватися самою системою, часто флуктуації розглядаються як відхилення від середніх станів системи. Флуктуації проявляють елементи дуальності у розвитку відкритих економічних систем.

По-перше, флуктуації можуть створювати нейтральний фон, який приводить в дію захисні механізми економічної системи, залишаючи систему на тому ж рівні стійкості завдяки механізмам негативного зворотного зв'язку та адаптації. Негативний зворотний зв'язок – це реакція системи, при якій її дії направлені в протилежну сторону у відповідь на дію фактора впливу. Іншими словами, система намагається протидіяти впливу зазначеного фактора, послаблюючи або повністю нейтралізуючи наслідки від його дії, щоб максимально зберегти свій попередній стан.

По-друге, флуктуації можуть створювати передумови для переходу на новий рівень стійкості через включення механізмів позитивного зворотного зв'язку. Позитивний зворотний зв'язок – це реакція системи, коли дії системи у відповідь на дію фактора впливу спрямовані в одну і ту ж сторону, що і напрямок фактору впливу. Іншими словами, система намагається посилити результати фактора впливу, змінюючи свій попередній стан.

Важливо відзначити, що при перебудові системи на інший рівень стійкості саме флуктуації виконують роль забезпечення багатоваріантності розвитку. Коли економічна система знаходиться у фазі біфуркаційного переходу, з великої кількості флуктуацій вибирається одна або кілька, які й визначають подальші шляхи розвитку соціально-економічних систем. Таким чином, дуалізм флуктуацій проявляється через реалізацію механізмів позитивного та негативного зворотного зв'язків. У разі реалізації механізмів негативного зворотного зв'язку енергія витрачається, щоб підтримати стан системи на незмінному рівні. У разі позитивного зворотного зв'язку – система змушена нести додаткові витрати на трансформацію (перебудову) свого стану.

Ключові слова: відкриті економічні системи, економічні флуктуації, економічний дуалізм, позитивний і негативний зворотній зв’язок.