

Time Duality in Economic Systems

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The purpose of this manuscript is to systematize methodological approaches to examine the duality of time in economic research. The main objectives of this paper can be considered as the study of researchers views on the nature of time duality at all, its manifestation in the economic theory, comparison of different visions about the impact of the time duality problem on contemporary development of economic system. This feature of the time effect on the economic processes has several associated symptoms, in particular: time-duration and time-order; basics of economic laws and limiting factor in the space-time development; qualitative and quantitative property; time as a relative definitions and categories and time as a specific measurement values; short-term and long-term phenomena; profit maximization problem and cost-minimization problem; time as an astronomical (calendar) and functional time; time as an interval duration and the irreversibility of its passage.

Keywords: development, duality, economic theory, functional time, time.

УДК 330.101.5

JEL Codes: A12, B41

Introduction. The influence of the time factor on the socio-economic processes for a long time period is the one of the key problems of economic research. Such researches are largely very indirectly concerned with the conceptual study of the time factor impact as a separate category of economic science. As an important issue of current research we see the necessity of research systematisation for the study of the role of the time factor in the economics in the contemporary studies of researchers. The purpose of this manuscript is to systematize methodological approaches to examine the duality of time in economic research. The main objectives of this paper can be considered as the study of researchers views on the nature of time duality at all, its manifestation in the economic theory, comparison of different visions about the impact of the time duality problem on contemporary development of economic system.

Main results of research. The theory of duality is a very important concept within the field of scientific research. This theory was first developed in relation to linear programming, but it has many applications, sometimes even more natural and intuitive interpretation, in several related areas such as nonlinear programming, networks and game theory.

In human everyday life time serves two functions: to measure the duration of the processes and determine the order of events. The possibility of such use is predetermined by the dual nature of the time phenomenon. Time-duration is in relation of complementarity to the time-order. With the increase of time units (unit of indistinguishable) decreases the error in determining the duration of the process and increases the error in determining the order. The multiplication of errors is a constant, which is specific to each of the physical, biological or social process.

Symbol t has a different meaning in the equations of motion in classical physics and in the postulates of thermodynamics, the theory of evolution (biological, space, geological, social).

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In the first case, the operator t is a time-duration, in other applications, the sense of the symbol is changing, and it is primarily the designation of time-order. Duration property and the property of the order do not exist without each other. In extreme cases, when a mistake or an error of duration reaches a zero, and the other –reaches infinity, time disappears.

Human activity and the objective processes of the material world are an infinite set of “tempo-worlds”, which are differ by the size of indistinguishable unit, but natural selection gives some advantage to their values, for example by imposing specific set of events of cosmic, biological and other rhythms. With the recognition of the time duality naturally solved some problems and paradoxes of chronosophy. Space is characterized by a similar duality of distance and order (Armand, 2009).

Evolutionary time does not “flow” smoothly. A calm development is regularly interrupted by crises. Increasing of order in biological systems associated with the accumulation of contradictions between the growing systems inertia and the ongoing development of the environment. Inconsistency is increasing and it leads to a new crisis. Such an intermittent course of evolution is typical for inanimate nature, earth and space, as well as economic, political, and technological development of society (Armand, 2009).

Time acquires its true meaning associated with the irreversibility or even with the “history” of the process, and it is not simply a geometric parameter characterizing the motion (Prigogine, 1978).

From a philosophical perspective of time, you can consider the following key options manifestation of its duality in different processes.

On the one hand, time is a *physical law*, establishing the direct effect of functional limitations on the existence of the changes taking place in the space of physical phenomena and events. However, on the other hand time is a *physical phenomenon*, representing the limit of existence of the changes taking place in the space of physical phenomena and events, and is an immediate basis for the formation of these changes.

In other words, time in the socio-economic systems can act on the one hand as a basis for establishing specific limitations of the laws, rules, etc. (in the form of economic laws) and, on the other hand, time itself is a limiting factor in the space-time development (life cycles, turnover time and payback period of capital, etc.).

The duality of time may occur in the presence of its simultaneous qualitative and quantitative properties as a distribution of certain functions of real phenomena and events. On the one hand, time is the relative qualitative value: evolution, continuity, synchronous and other characteristics of the processes. On the other hand, of course it is a quantitative: speed, duration, etc. At the same time, qualitative and quantitative characteristics and the properties of time are completely interdependent and intercausing.

In addition, perhaps as a resulting consequence of the above mentioned, the time may have a dual display in the form of its presentation: the relative definitions and categories (yesterday, past, future, planning and the actual period, strategy and tactics, etc.), or vice versa specific measurement values (seconds, minutes, hours, days, years, etc.).

Significant scientific interest is the deep study of the socio-economic phenomena that can move in different directions along the time axis. How significant is the difference in the analysis of the spatial and temporal development of the socio-economic systems? How significant and measurable for economic phenomena are changes in the causal chain of events? Is it possible to estimate, underestimate or overestimate the fact that the factor analysis of the socio-economic phenomena (as opposed to physical) is significantly more often “sin” by rapid transition from cause to result and from result to cause?

Is it a significant problem for the economy the analysis of time as a sequence of past, present and future periods? In other words, are in fact uncontrollable past and unpredictable future able to have a real impact on the current moment or it do not make sense at all to take them into account? And what is really rational from an economic perspective to consider as the current period (moment)?

According to D. Meadows, by and large, from a systemic point of view there is no distinction between short-and long-term prospects. The phenomena of different time scales simply attached one into another. Some actions that are taking place today will have consequences that occur almost immediately, and others – many years later. The art of management in economics is the ability to see both short-term and long-term prospects. In her point of view, economics time horizons are limited by political elections or by the return period of investment, while the family time horizon is much larger, and historically humanity trying to plan their lives for much longer periods of time. The wider time horizon, the more chance there is for further progressive development (Meadows, 2010).

Time is a dual concept and therefore it also has a wave-particle duality. If the external time has the property of discrete, then the internal time will have the property of continuity (Bieliaiev, 2005).

On the other hand time is a fundamental, system concept of economics. The influence of the time factor in the socio-economic processes for a long time is the one of the major problems of economic research. The influence of the time factor in the economic process in any case is difficult to exaggerate, it is much easier to simplify and reduce it to narrowed practical use in the economic analysis (Derev'yanko, 2012).

Since the early 1970s, the use of dual techniques has become widespread among economists. Familiarity with basic duality theory is to be taken for granted among researchers, whether their interest is in economic theory or in empirical applications of that theory. In view of this, the paucity of simple introductory expositions of these techniques is both surprising and disappointing. The existing microeconomic textbooks understandably mix duality in with a lot of other material, which is fine for the current generation of modern researchers, but inconvenient for those who have a strong orthodox microeconomic background and who wish to catch up with recent developments in the techniques of modelling (Cornes, 1992).

To our view the classic manifestation of the dualism theory in the economy can be considered as the fact that the solution to the profit maximization problem is also a solution to the cost-minimization problem with same production function and input prices.

Time can act in the economic processes as astronomical (calendar) and functional time. Objective and real, functional time form a physical, biological, chemical, social, economic, and any other real processes.

Time in economics expresses an order of irreversible sequence in economic activity and cognition. Rather fully reflection of temporal aspects of economics and economic theory is a particularly difficult and almost unsolved problem. Nevertheless, in the scientific literature a variety of time categories are selected which are corresponding to different types of processes in economics.

A particular difficulty of temporal aspects of economics in economic theory, the pendency of this problem stemmed from the fact that experts in economic theory examine economic processes, using the astronomical or calendar time, which are postulated and “time” invented by humanity. The same are all the categories of time, which are ostensibly correspond to different types of processes in the economy or which are characterized economic activity. But this approach to the research of economic processes exclude the possibility of identifying, let's

say, of the internal dynamic laws of their flowing, which cannot be detected using conventional units of time. Identifying of new regularities of economic processes and usage of them for solving the existing problems in the economy, including global, is possible only if the experts on economic theory will benefit the functional economic time in their research. The fact is that in objective reality there is only a functional time. In this regard, experts in all fields of science, while examining specific economic processes must operate with the concept of functional time.

Objectively, there is only a functional time, which is formed by all, without exception, actual processes, including economic. Only functional time is objectively exist, because it formed by the real processes. In other words, each process takes place (exist) at the time, which is formed by the sequential change of it qualitatively new conditions and does not depend on a person's consciousness.

Astronomical time and calendar time, as they are postulated and invented by a human is not correct to call objective, regardless of whether they are attached to economic or other process (postulated are the moments of time that have nothing corresponding to them in objective reality) (Lolaiev, 2009).

Consideration of the time specific as an economic resource and its comparison with information and other resources has led to the need of introduction the term time "bivalence" (in our opinion this statement is a consequence of the time dualism), which characterizes its specific set of interval duration (number of hours) and the irreversibility of its passage. This concept describes the fundamental difference between the time as an economic resource that is associated with the feature of its scarcity. In contrast to labour and capital, which are available in case of their non-use in economic sense, non-use of time affects the amount of time at our disposal in the same way as it is using. This economic feature is fundamentally restricts the possible way to use the traditional factor approach and its criteria of efficiency (productivity) to the time.

Developed a systematization of economically important time properties as a resource, showed the nature of the difficulties of the traditional use of the resource approach to economic time. Consistent inclusion of time bivalence as an economic resource and the concept of time-consuming need to draw distinctions between the so-called static and dynamic resources. It is noted that the doubling of economic time characteristics must comply with the doubling of concepts that describe the actual processes of post-industrial time-consuming economics that meets the time transformation from exogenous to endogenous parameter of economics. In this research author use the concepts of static and dromology resource, static and dynamic value, reversible and irreversible components of the time evaluation and other economic resources (Baskin, 2006).

Conclusions. An important result of this research we consider valid evidence of the dual nature of the time factor in the socio-economic life. This feature of the time effect on the economic processes has several associated symptoms, in particular: time-duration and time-order; basics of economic laws and limiting factor in the space-time development; qualitative and quantitative property; time as a relative definitions and categories and time as a specific measurement values; short-term and long-term phenomena; profit maximization problem and cost-minimization problem; time as an astronomical (calendar) and functional time; time as an interval duration and the irreversibility of its passage.

As an important area for further research we consider study of the impact of time duality on specific developments processes in the economics of the enterprise or the region (country),

distinguishing features influence of the time factor on the results of economic agents' development.

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Manuscript received 11 March 2013.

Дуализм времени в экономических системах

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Целью этой статьи является систематизация методологических подходов к изучению дуализма (дуальности) фактора времени в экономических исследованиях. Основными целями данного исследования являются: изучение взглядов учёных на природу двойственности (дуализма, дуальности) времени в целом, её проявление в экономической теории, сравнение различных взглядов на влияние проблемы дуальности времени на современное развитие экономических систем. Особенность влияния дуальности фактора времени на социально-экономические процессы имеет несколько взаимосвязанных проявлений, в частности: время-дление и время-порядок, время как основа экономических законов и ограничивающий фактор в пространственно-временном развитии; качественные и количественные свойства; время как относительные определения и категории и время как конкретные значения измерений; краткосрочные и долгосрочные явления; время как проблема максимизации прибыли и минимизации затрат; астрономическое (календарное) и функциональное время; время как экономический ресурс, характеризующийся интервальной длительностью и необратимостью хода.

Ключевые слова: время, дуализм, развитие, функциональное время, экономическая теория.

Дуалізм часу в економічних системах

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Теорії дуалізму є дуже важливою концепцією в галузі наукових досліджень. Ця теорія була вперше розроблена у галузі лінійного програмування, але вона має багато напрямів використання, в т.ч. природничу та інтуїтивну інтерпретацію в деяких суміжних галузях знань, зокрема, нелінійне програмування, мережева теорія та теорії ігор.

Метою даної статті є систематизація методологічних підходів до вивчення дуалізму (дуальності) фактору часу в економічних дослідженнях. Основними задачами даного дослідження є: вивчення поглядів вчених на природу двоїстості (дуалізму, дуальності) часу в цілому, її прояв в економічній теорії, порівняння різних поглядів на вплив проблеми дуальності часу на сучасний розвиток економічних систем.

Особливість впливу дуальності фактору часу на соціально-економічні процеси має кілька взаємопов'язаних проявів, зокрема: час-тривалість і час-порядок (у побуті час виконує дві функції: служить для вимірювання тривалості процесів і встановлення порядку подій); час як основа економічних законів і обмежуючий фактор в просторово-часовому розвитку (час у соціально-економічних системах може виступати з одного боку в ролі основи для встановлення певних обмежуючих економічних законів, правил, а з іншого боку сам час і є чинником обмеження в просторово-часовому розвитку); час, як якісна та кількісна характеристики явищ; час як відносні визначення і категорії (вчора, в минулому, в майбутньому, плановий і фактичний період, стратегія і тактика інше) і час як конкретні значення вимірювань (секунди, хвилини, години, дні, роки інше); час, як короткострокові та довгострокові явища; час як проблема максимізації прибутку та мінімізації витрат (розв'язання проблеми максимізації прибутку є також вирішенням проблеми мінімізації витрат, за умови незмінної виробничої функції і вартості ресурсів); астрономічний (календарний) і функціональний час; час як економічний ресурс, що характеризується інтервальною тривалістю і необоротністю ходу.

Час в економіці виражає впорядкованість незворотної послідовності в економічній діяльності й пізнанні. Досить повне відображення часових аспектів економіки в економічній теорії – особливо складна, багато в чому не вирішена задача. Проте в науковій літературі виділено цілий спектр категорій часу, що відповідають різним типам процесів, що протікають в економіці. Особлива складність часових аспектів економіки в економічній теорії, невирішеність цього завдання зумовлені тією обставиною, що фахівці з економічної теорії досліджують економічні процеси використовуючи астрономічний або календарний час. Об'єктивно ж існує лише функціональний час, який утворюється усіма без винятку реальними процесами, в тому числі й економічними.

Ключові слова: дуалізм, економічна теорія, розвиток, функціональний час, час.