UDK 001.9:330.34:52-55-047.64

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Natural Foundations for Management of Balanced Economic Development. Part I. The transition to management concepts based on the physical economy[1]

The economic management should be considered as a component of the nature and rely upon the laws analogous to the ones of the nature. Unlike the nature with its implicit capacity to reproduce, the economy needs conscious management. The theoretical and practical framework for economic management needs to build on theoretical and applied knowledge pertaining to the needs of the economic development harmonized with the nature. The study aims to substantiate physical and economic foundations for management of economic development.

Theoretical framework for the economic development strategy is studied from the perspective of the unique intellectual legacy of S. Podolynskyi, as well as V. Vernadskyi and M. Rudenko who continued and elaborated physical-economic ideas of their outstanding predecessor. The innovative results of Ukrainian scientists in physical economy, conforming to the arguments of advanced management theories, form physical-economic knowledge based on the natural principles of balanced economic development.

It is concluded that the fundamental principles of nature underlying economic management in our times are (i) keeping with the law of energy conservation, and (ii) consideration for energy distinction between the living and the non-living. These fundamental scientific theses have the critical role in sustaining the economic balance and the long-term development of economic management..

Key words: *physical-economic knowledge, economic balance, long-term economic development, management of economic development, physical economy.*

The economic management should be considered as a component of the nature, being changed by the societies in the process of their life. It means that its development has to rely upon the laws analogous to the ones of the nature.

The economic management, like the nature, is an extremely complex existential sphere. Its complexity results from its going beyond the frontiers of the living and the increasingly intensive interference in the spheres of non-living and rational. The economic management thus becomes complicated to the extent making its development even more problematic. Because while the nature is implicitly capable to reproduce its balance in the long run, the economy can only be balanced by the human effort and managerial capacities turning the human reason and labor to productive use of the living, the non-living and the rational.

However, unlike the nature with its implicit capacity to reproduce, the economy needs conscious management. Therefore, the advanced scientific and practical framework for economic management needs to build on theoretical and applied knowledge pertaining to the needs of the economic development subordinated to the nature and harmonized with it. It refers to fundamental natural foundations of the economic management; once comprehended and followed, they open up the way for the development pattern under study.

Ideas on nature and economics, devised by European physiocrats of 18 century like French physician F. Quesnay and German physician and naturalist R. Mayer had the critical theoretical contribution in the economic management field. These ideas were extended on innovative theoretical grounds by S. Podolynskyi, a Ukrainian scientist and public activist of 19 century, and V. Vernadskyi, an academician, an outstanding naturalist and thinker of 20 century. In our times these ideas were reinvented and rethought by M. Rudenko, a Ukrainian intellectual, a writer and a human rights advocate.

It is noteworthy that the ideas of all our compatriots overlapped chronologically with the appearance of an array of managerial paradigms in 19–20 centuries, especially with basic research in theoretical and applied cybernetics, addressing economic challenges of that time. The innovative results of Ukrainian enthusiasts, therefore, conformed to the statements of basically new management theories.

Contemporary scientists study economic development and economic management problems at macroeconomic, sectoral and industry level. A. Halchinskyi,

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[1] *Основні тези статті викладено автором у публікації: Шевчук В.О. Рівноважність і довготривалість економічного розвитку: зміна парадигми управління на засадах фізичної економії / В. О. Шевчук // Вісник Хмельницького національного університету. – 2014. – № 6, Т. 1. – С. 282–292.*

V. Heyets and others address economic development issues from methodological perspective [1;2]. I. Yukhnovskyi projects them on the medium-term development strategy of Ukraine and on a longer run [3].

Works by V. Heyets, V. Seminozhenko and B. Kvasniuk are focused on the knowledge-based economy as a modernization project for Ukraine, innovation-driven and technological development of the Ukrainian economy and its competitiveness [4]. Studies of O. Bilorus and others are devoted to the security of economic development in the globalization context [5].

Works by M. Zubets, V. Zhuk, Yu. Lupenko, V. Messel-Veseliak, P. Sabluk, O. Shpychak and other agrarian economists highlight key problems and development prospects in the agrarian sector of the Ukrainian economy [6; 7; 8]. Studies of L. Shynkaruk are devoted to structural change and economic development in Ukraine [9], works by O. Amosha and others address challenges and developments in the Ukrainian metallurgy [10], the monograph of M. Sharko elaborates the conceptual framework for the innovation-driven development of the Ukrainian economy [11], publications of

N. Karachina, A. Kryzhna and O. Rudnieva are devoted to the current performance, tendencies and future development of the mechanical engineering industry in Ukraine [12; 13]. Important studies of vital problems in economic management are made by I. Ihnatieva [14], O. Kendiukhov [15], O. Raievnieva [16], D. Stechenko [17] and other Ukrainian scientists.

A critical review of their studies demonstrates that management of economic development needs to be based on physical economy and grounded theoretically by use of the gains of the pioneers of the Ukrainian academic school of physical economy [18].

The study aims to substantiate physical and economic foundations for management of economic development. It refers to the need for building the theory and practice of management on the mix of classical and novel theses on economic management, created by the enthusiasts of European science from 18 to 21 centuries and supplemented by the gains of S. Podolynskyi, an original Ukrainian scientist, academician V. Vernadskyi, the founder of the Ukrainian Academy of Sciences, and M. Rudenko, our contemporary. Their singular scientific legacy, underestimated by contemporary scientists and practitioners, enables for delineating economic management contours by physical economy principles, to make them adequate for global challenges of 21 century.

Ukrainian enthusiasts of physical economy used the results of their outstanding predecessors in interpreting economic management as productive use of the living, the non-living and the rational. They referred to the symbiosis of these spheres, which implies projection of the living on the non-living, guided by the rational.

According to M. Rudenko who gave his own interpretation to this symbiosis by treating the rational as interactions of Logos (covering, in his interpretation, science, literature, arts etc.) and State, thinking and governing might be withdrawn from the sphere of the rational. In the context of this study, the existing gains of economics are going to be divided into two branches, in M. Rudenko' manner, with physical and economic component considered as the primary and core natural basis for overall human and domestic economic knowledge, and its political and economic branch considered as the secondary one deriving from the basis.

As regards governing, it is considered by us as an analogue of controllability ensured by the government at highest (central) and lowest (local) political level. Governing and economic management in business enterprise sector is proposed to consider as management in its broader sense.

Reference needs to be made on the combined use of the significant but underemployed potential of physical-economic and managerial ideas of S. Podolynskyi and B. Trentovsky [19; 20], V. Vernadskyi [21–23] and N. Wiener [24], M. Rudenko [25] and V. Hlushkov [26; 27]. This potential, if utilized through effective combination of their innovations, will be capable to radically change the existing paradigm underlying the theory and practice of economic management.

Emphasis needs to be made on the two aspects of economic management: target and functional ones. By the interpretation used in this study, the first aspect refers to controllability of productive economic use of all the above existential spheres: the living, the non-living, and the rational. The second aspect refers to functions of economic management: planning and rationing, accounting and statistics, control and analysis, regulation (justification and approval of management decisions) etc.

In both studied contexts, economic management needs to be interpreted as a system. Each of them constitutes the complex of subsystems: the managing entity, the managed entity and their interactions with each other. These complexes are continual: on the one hand, when some of the subsystems is missing, managerial functions and the macroeconomic management will fail, on the other hand, the unity of managing and managed entities and their interactions will ensure the management actions. They can be interpreted as individual functions of economic development or as the functional totality which, if maintained, allows for controllability in the above mentioned management segments.

The economic development is going to be considered as management object, and the development parameters – as management subject. It will enable to find out important qualities of economic development

from among the selected physical and economic positions of the study, which, if maintained, will enable the development.

Of the laws underlying the development of domestic or global economic and socio-economic life of the humankind as a whole, the energy conservation and law is of primary importance. The scientific priority in its theoretical grounding belongs to the above mentioned F. Quesnay and R. Mayer. Theoretical and practical significance of this law was emphasized by our outstanding compatriots.

There's another fundamental discovery of R. Mayer with the essential scientific importance in the context of the study. He was "the first to realize that green plants changed the Earth's crust energy. They turn the solar rays' energy into a new form and consume it in a way favorable for chemical processes that develop on our planet". Yet, according to V. Vernadskyi, these ideas of R. Mayer remained incomprehensible even later on, long after his ideas on unity and conservation of energy penetrated into the scientific thought [22, p. 356].

The results of scientific analysis of energy phenomena discovered by R. Mayer led academician V. Vernadskyi to his own conclusions of fundamental significance: R. Mayer dealt with the phenomena of life, which were the deepest of all that had been subject to scientific studies by his time. "From this point of view, the two broader phenomena in the process of life immediately attract our attention: first, the existence of clear-cut frontier between the living and the rigid substance; second, very special nature of energy related with the manifestation of life" [22, p. 357].

It refers to thermodynamic processes that are critical from the perspective of economic balance. Vernadskyi said that apart from R. Mayer, these problems were addressed by other founders of thermodynamics, like W. Thomson (Baron Kelvin) or H. Helmholtz. However, their short, but very clear suggestions, thoughts and facts concerning energy distinctions between the living and the non-living were comprehensible and acknowledged. It was later that S. Podolynskyi who died early could understand all alone the significance of these ideas [22, p. 360].

Furthermore, S. Podolynskyi attempted to apply them to studies of economic phenomena. His innovative approaches gave him the global priority in creating a crucially new field of economics, physical economy, which made the young researcher the founder of the Ukrainian academic school in the field.

This priority is in the independent study of the problems by our scientist, which had been approached only by few intellectuals. The Ukrainian scientist addressed thermodynamics problems which complexity could not be comprehended even by the experts of that time. Also, the global priority of S. Podolynskyi is in applying the ides of energy distinction of the living from the non-living to economic phenomena.

It follows that apart from the law of energy conservation, the distinction between the living and the non-living needs to be considered as the natural fundament for balance, particularly in scientific interpretation from physical economy perspective and for applications purposes. This distinction, established by S. Podolynskyi, is proposed to be laid as the basis for the analysis of balanced condition and balanced development of the living and the non-living as the spheres of productive use. In showing the rational for the economic management strategy, these theses will be specified by us with reference to the scientific legacy of academician V. Vernadskyi and M. Rudenko who elaborated the ideas of S. Podolynskyi.

The intellectual legacy of academician V. Vernadskyi has very valuable theses and empirical conclusions that have much to do with the studied problems. His legacy should be used as the analytical framework in addressing the problems which solutions still remain central to the domestic economy and management of its balanced development in 21 century. The studies of this outstanding thinker deal with the balance of the substance coming to Earth from Cosmos, on the one hand, and returned by Earth into its surrounding space and absorbed by Cosmos, on the other hand. Academician V. Vernadskyi formulated the thesis that the substance of the planet does not change in geological time. The substance received by our planet is equal to that given by it [21, p. 313].

In the last years of his life, he came to the conclusion that was critical for further existence of the living, including future life of the planetary humankind, that the living substance has existed during the whole geological time, being geologically eternal [21, p. 326]. Retrospective analysis of his works allows for finding out the scientific way that led him to this conclusion. Because in the context of this study, this conclusion of Vernadskyi as a naturalist is especially valuable for its laying the scientific fundament for the strategy of economic management that would be balanced and lasting.

The balance in the nature was part of the problems studied by the thinker. The scientist went deep into its theory. For his research needs he created his own scientific typology of balance.

Academician V. Vernadskyi showed that solar ray, as a carrier of cosmic energy, not only incites the mechanism for its transformation into earthly chemical energy, but creates the form of transformers, which appears to us in form of the living nature. The scientist demonstrated that these phenomena were everywhere subordinated to the laws of equilibrium and had to be expressed numerically [21, p. 105].

As a naturalist, academician V. Vernadskyi demonstrated the thermodynamic balance in biosphere,

which is very important in terms of ecological-economic development, which imbalance he could confirm by analyzing geochemical activities of humans. He argued that the balance in migration of elements, established in course of geological times, can be broken by human intellect and action. Nowadays, we are in the period when the conditions for thermodynamic balance within the biosphere are changing in this way [22, p. 369].

The problems dealt by the thinker cover the distinction between the living and the non-living nature, which has to do with economics and was addressed by S. Podolynskyi. Remembering this, the irrefutable priority of S. Podolynskyi in its solution was emphasized by V. Vernadskyi from the results of a comparative analysis of contributions from foreign and Ukrainian scientists [22, p. 360]. S. Podolynskyi is indeed the one who was the first to approach the energy distinction between the living and the non-living in the economic context.

Bearing in mind the fundamental importance of these issues for the socio-economic practice in 21 century, we believe that their analysis is central to scientific justification of the national economy development strategy. The reason for this analysis is the scientific theses on the balanced planetary existence of Earth, devised by academician V. Vernadskyi, which, as mentioned above, he divided into the living, the non-living and the rational, with productive use of these spheres referred to as economic management.

These theses include the conclusions set out in his last publication printed in his lifetime, the article "Few Words about the Noosphere" [21, p. 322–333]. The abovementioned conclusions of the thinker about the eternity of life are extremely valuable for the contemporary interpretation of the balanced development processes. However, this attributive character (and, therefore, leaving no alternative) is not always duly considered in the existing definitions of development, where the balanced process in thermodynamics, the process of transforming a thermodynamic system from one condition to another one is treated as slow to the extent that all the intermediate conditions can be regarded as balanced ones, whereas the balanced process is characterized by the infinitely slow change in thermodynamics parameters of the condition [28].

On the one hand, the thesis about the eternity of life, proved by V. Vernadskyi, needs to be considered as the fundament of nature, to be laid in the basis of economic development. On the other hand, the problem of balanced long-term economic development becomes more complex because of an integrative mission imposed on it in 21 century. The contemporary economy is supposed to be the harmonic symbiosis of the living, the non-living and the rational, with the sphere of the living being the crucial one. However, there's a threat of its ruining due to misuse of the non-living sphere, of which V. Vernadskyi was warning.

While emphasizing in the above mentioned article "Few Words about the Noosphere" that the great future will open for a human", the thinker had to warn that "if he will understand it and won't use his intellect and effort for self-ruining [21, p. 330]. A human as the medium of the rational, guiding his effort to have the living preserved rather than destroyed, is, therefore, responsible for future.

The sustainable development should be considered as a form of balance. According to a number of theoreticians and advocates of the sustainable development, it is the most advanced ideology of 21 century and even of 22 century; once elaborated further on more solid scientific grounds, it will replace all the existing ideologies as the ones incapable to sustain the balanced development of the civilization [29].

Academician M. Moiseiev, a distinguished Russian researcher, attempted to interpret "the politicized" (as he put it) notion of sustainable development in the scientific sense, as the quest for a strategy for transition to the society capable to sustain the conditions for co-evolution of Nature and human, which basis is the scientifically elaborated doctrines (taboo) and very gradual adoption of them [30, p. 80].

We believe that such interpretation is fraught with "washing out" the essential meaning of the notion "sustainable development", introduced by the international community to denote this type of development. Therefore, whenever the definition of this life-asserting notion, which is vital for the international community, is modified, care must be taken to address the interests of present-day and future generations alike. Only this approach will conform to the idea of geological eternity of the living, devised by academician V. Vernadskyi.

The important physical and economic ground for studies of the balanced and lasting economic development is laid by M. Rudenko, a modern Ukrainian writer and human rights advocate, a philosopher, a cosmologist, and economist. His works on economic philosophy contain a number of theses with special importance for justification of the strategy for balanced management of the socio-economic sphere.

The most significant are the theses on effects and uses of the energy conservation law. Our contemporary could grasp deeply the significance of the fundamental law of the nature for the economic development of human societies.

The balance of absolute and relative wealth was seen by M. Rudenko as a manifestation of this universal law in the economic management field. This problem is solved on physical economy grounds in one of his essays on economic philosophy [25].

The researcher drew clear distinguishing line between absolute wealth and relative wealth. He emphasized the need for maintaining their strict balance. M. Rudenko demonstrated that the essential meaning of

this balance could be revealed only through the energy conservation law. While absolute wealth originates from the energy of the living, relative wealth results from the changing form of the non-living. This change occurs due to consumption of the living substance energy when making non-eatable goods, thus confirming the effect of the energy conservation law.

The causality of absolute and relative wealth needs the continual balance by definition. It has theoretical and applied significance, because it helps solving economic, social, political and other problems of purely practical purpose. While absolute wealth and relative wealth needs to be in the condition of constant balance, the social and property status of the social classes employed in generating of absolute wealth and making of relative wealth, respectively, needs to be in the long term balance. Because it determines the universal balance crucial for the existence of Earth.

Our contemporary proved the theses confirming the validity of S. Podolynskyi' ideas and V. Vernadskyi's conclusions on non-transcending distinction between living and rigid natural bodies in the biosphere, sharp energy and material distinction between living organisms and rigid bodies in the biosphere [23, p. 508]. He developed their theses by arguing that "the distinction between the organic world and the non-organic world is that every organic substance, in contrast to a mineral one, is a medium for solar energy" [25, p. 368].

This lays grounds to the following arguments of primary significance for the management of economic development. The balance of absolute and relative wealth is a manifestation of the physical-economic balance. Studies of M. Rudenko are the innovative continuation of the theories implemented in the global science by S. Podolynskyi; as shown above, he was the first to apply the idea of energy distinction between the living and the non-living to studies of economic phenomena. Also, studies of our contemporary are the extension of the results by academician V. Vernadskyi who emphasized this distinction and showed the insurmountable frontier between the living and the rigid.

In his work "Balance of Absolute Wealth and Relative Wealth", M. Rudenko gave the formula presented as the equation of capital [25, p. 372]:

$$K = E - F, \quad (1)$$

where K – capital, E – energy, F – entropy.

This equation should be considered as a modified version of the formula for the energy of progress proposed by M. Rudenko, if presented as:

$$E = K + F. \quad (2)$$

This is one of the five versions of the formula; the other ones are given in graph form, irrespective of their physical-economic or metaphysical meaning [22, c. 359, 362, 363]. At the same time, it is the only version of the formula, presented in strictly mathematical and well-marked form.

It should be stressed that "the energy of progress" is a fundamental economic concept introduced in scientific parlance by M. Rudenko [25, p. 66]. This thinker showed that the energy of progress was a physical analogue of the absolute value added [25, p. 295, 297]. The latter was defined by him as "annual surplus of the solar energy that occurs in crop farming only" [25, p. 16]. Accordingly, K should be treated as the annual surplus of absolute capital generated due to E, and F – as the annual absorption of a part of E for purposes of industry and government. On the one hand, F is dispersion of energy in the global space. On the other hand, if F is not wasted but transformed in relative capital, it will be capable to lay the material and technical basis for economic development.

M. Rudenko interpreted wealth as a synonym of capital. The balance of absolute and relative wealth that he studied can, therefore, be interpreted as the balance of absolute and relative capital. Thus, the formula (1) enables for describing the economic balance by the criterion of absolute capital. The economic balance can be described by the criterion of relative capital on the assumption that the entropy, apart from dispersing or wasting the energy it generates, is capable to transform the energy into relative capital. Then:

$$F = E - K. \quad (3)$$

The formula (1), therefore, reflects the equality between absolute capital, on the one hand, and the energy of progress it generates and the resulting entropy, on the other hand. Besides that, according to M. Rudenko, the essential meaning of the balance as the subject for management of economic development can be shown by: formula (2), equalizing the received energy of progress with the generated absolute capital and the satisfied entropy needs of societies; formula (3), equalizing the entropy with the received energy of progress compensating the entropy, and the generated absolute capital. When the potential increase of absolute capital is analyzed by each equation taken as a function with extreme points, it will be found that the first equation describes the conditions for its maximization, the second one – the conditions for energy of progress maximization, and the third one – the conditions for entropy minimization.

As regards the generic description of economic balance, it can be tentatively described by the equation:

$$E - K = F. \quad (4)$$

E in the left side of the equation denotes the total annual surplus of absolute value added, and K denotes the part of this surplus meat for further increase of E and assurance of economic development. F in the right side of the equation means the annual consumption of the part of E which, if allocated to satisfy the needs of industry and government, can be potentially transformed in relative capital. This approach allows for the physical-economic vision of the capitals, en-

abling for the conscious impact on the development of economic management.

The above formulas need to be used as the framework in constructing the integrated model for economic balance, which is ontologically built on the principles of the fundamental law of energy conservation. The conscious management of the balanced long-term economic development, by maintaining the balance in economic management in particular, has to ensure generation of absolute wealth and making of relative wealth in the productive sector.

Summing it up, the fundamental principles of nature underlying economic management in our times are (i) keeping with the law of energy conservation, and (ii) consideration for energy distinction between the living and the non-living. These fundamental scientific theses have the critical role in sustaining the economic balance and the long-term development of economic management. Formulated earlier by French physiocrat F. Quesnay and German naturalist R. Mayer, in 19–21 centuries they were elaborated by Ukrainian intellectuals: S. Podolynskyi, V. I. Vernadskyi, M. Rudenko and others. Yet, their unique scientific gains have been underestimated by contemporary Ukrainian and foreign practical and theoretical economists.

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Природничі підвалини управління рівноважним економічним розвитком. Частина І. Перехід до концепції управління на підґрунті фізичної економії

Досліджено сучасне наукове обґрунтування стратегії управління розвитком економіки на основі унікальної інтелектуальної спадщини С. Подолинського, а також В. Вернадського і М. Руденка, які продовжили та творчо розвинули фізико-економічні ідеї свого видатного попередника. Новаторські здобутки наших співвітчизників на теренах фізичної економії узгоджуються з положеннями новітніх теорій управління та формують фізико-економічне знання, засноване на природничих засадах забезпечення рівноважного розвитку економіки.

Ключові слова: *фізико-економічне знання, економічна рівновага, довготривалий розвиток економіки, управління розвитком економіки, фізична економія.*

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Естественные основы управления сбалансированным экономическим развитием. Часть I. Переход к концепции управления на базе физической экономии

Исследовано современное научное обоснование стратегии управления развитием экономики на основе уникального интеллектуального наследия С. Подолинского, а также В. Вернадского и М. Руденко, ко-

торые продолжили и творчески развили физико-экономические идеи своего выдающегося предшественника. Новаторские достижения наших соотечественников в области физической экономии согласуются с положениями новейших теорий управления и формируют физико-экономическое знание, основанное на естественных началах обеспечения равновесного развития экономики.

Ключевые слова: *физико-экономическое знание, экономическое равновесие, долгосрочное развитие экономики, управления развитием экономики, физическая экономия.*

Bibliographic description for quoting:

Shevchuk, V. O. (2016). Natural Foundations for Management of Balanced Economic Development. Part I. The transition to management concepts based on the physical economy. *Statystyka Ukrainy – Statistics of Ukraine, 4, 76–83* [in English].

Бібліографічний опис для цитування:

Шевчук В. О. Природничі підвалини управління рівноважним економічним розвитком. Частина І. Перехід до концепції управління на підгрунті фізичної економії (публікується англійською мовою) / В. О. Шевчук // Статистика України. – 2016. – № 4. – С. 76–83.

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