

## ECONOMIC THEORY OF POTENTIAL. QUASI AXIOMATIC APPROACH TO MODELING AND MEASUREMENT

*Abstract – Quasi axiomatic approach to the development of coherent general economic theory of potentials and its ability to ensure the theory coherence. Quasi axiomatic approach to the development of the theory and main results of its implementation are considered using the case study of one of the directions of the development of economic theory of potential. It is shown that strict compliance of this approach, starting with defining the basic notions, stipulates possible ways of the theory development, methods of occurred tasks solution and directions of theoretical results efficient application in business activities, whereas quasi axiomatic approach itself is practical tool for provision of economic theory of potentials coherency as an integral set of certain scientific knowledge. Basic provisions of quasi axiomatic approach to the development of general economic theory of potentials.*

*Key words: enterprise potential, axiomatic approach, modeling, evaluation.*

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## ЕКОНОМІЧНА ТЕОРІЯ ПОТЕНЦІАЛІВ. КВАЗІАКСІОМАТИЧНИЙ ПІДХІД ДО МОДЕЛЮВАННЯ ТА ОЦІНКИ

*На прикладі робіт одного з напрямків розвитку економічної теорії потенціалів розглянуто квазі-аксіоматичний підхід до побудови теорії та основні результати його реалізації. Продемонстровано, що суворе дотримання цього підходу, починаючи з визначення базових понять, обумовлює як можливі шляхи розвитку теорії, методи розв'язання виникаючих завдань, та напрямки ефективного застосування теоретичних результатів у господарській практиці, а сам квазіаксіоматичний підхід є дієвим інструментом забезпечення внутрішньої несуперечності економічної теорії потенціалів як цілісного зводу певних наукових знань.*

*Ключові слова: потенціал підприємства, аксіоматичний підхід, моделювання, оцінка.*

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## ЭКОНОМИЧЕСКАЯ ТЕОРИЯ ПОТЕНЦИАЛОВ. КВАЗИАКСИОМАТИЧЕСКИЙ ПОДХОД К МОДЕЛИРОВАНИЮ И ОЦЕНКЕ

*Квазиаксиоматический подход к построению внутренне непротиворечивой общей экономической теории потенциалов и его возможности в обеспечении внутренней непротиворечивости теории. На примере работ одного из направлений развития экономической теории потенциалов рассмотрен квазиаксиоматический подход к построению теории и основные результаты его реализации. Продемонстрировано, что строгое соблюдение этого подхода, начиная с определения базовых понятий, обуславливает как возможные пути развития теории, методы решения возникающих задач и направления эффективного применения теоретических результатов в хозяйственной практике, а сам квазиаксиоматический подход является действенным инструментом обеспечения внутренне непротиворечивости экономической теории потенциалов как целостной совокупности определенных научных знаний. Основные положения квазиаксиоматического подхода к построению общей экономической теории потенциалов.*

*Ключевые слова: потенциал предприятия, аксиоматический подход, моделирование, оценка.*

**Formulation of the problem.** In recent years, the economic theory of potentials has received much attention from economic scientists, as demonstrated by a large number of scientific publications and text editions concerning various aspects of the theory. At the same time, the following two facts are to be noted. The first is an amazing variety of interpretations of the notion of potential in economics, and the second is a surprising uniformity of methodological approaches to the evaluation of potentials. This situation appears paradoxical as the qualitative differences in defining the basic notion of the theory and its economic content (in fact, different scientists understand quite different objects by potential) must inevitably lead to substantial differences in the approaches to evaluating the level of potentials.

When the causes of this situation are revealed, it is apparent that the major cause is to be sought in a failure of many researchers to comply with the fundamental principles of constructing theories, as well as in numerous deviations from the rules of logic, from defining the notion of potential in economics to formulating the tasks of managing potentials, which leads to eclectic constructions and emergence of contradictory points in the theory as a system of knowledge. In these circumstances, the task of axiomatizing the theory of potentials in economics and demonstrating possible ways of its realization with regard to specific character of economics as a science, as well as the effectiveness of applying certain approaches, is of current interest.

**Analysis of the latest research and publications.** The article systematizes the theoretical views and developments presented in publications by I.N. Karapeychik, A.B. Alyokhin, A.B. Brutman, N.N. Vanina, V.A. Dilenko and S.I. Savchuk and devoted to the theoretical bases of economics of potentials with the emphasis on the methodological and methodical aspects of the problem of quantitative measurements of potentials, as well as similar synthetic signs of economic entities such as viability and competitiveness [1–9].

On the background of various definitions of the notion of potential which can be found in the economic literature, these authors substantiate the expedience and the necessity of interpreting this notion as a certain capability of economic entities (by analogy with the theory of competition and the concepts of viability and competitiveness) [1–13]), as well as give constructive criticism of alternative interpretations of the notion of potential and analyze the reasons of their emergence [1, 10, 12]. The notion of potential as a strictly defined ability of an economic entity, makes it possible, on the one hand, to propose a constructive approach to the classification of various types of potentials in economics and to show shortcomings of the existing approaches to the classification of potentials and eclectic elements in their construction [15, 16] and, on the other hand, to research peculiar features of potentials (of viability and competitiveness) as objects of measurement [1, 2, 4, 6–8, 14, 17] and to propose a fundamentally new optimization approach to these measurements [1, 3–5, 7, 9, 18–20]. An important stage in the development of the economic theory of potentials in this direction was the introduction of the concept of potential function as a generalized representation of the level of potential as a scalar value into the system of concepts of the theory [3, 21]. As a basic tool for analyzing and measuring the potential of economic entities, determined the form of potential function, as well as other related signs, the authors of this trend in the theory of potentials proposed to use methods of statistical tests and multivariate statistical analysis [1, 4, 7, 17, 22–26]. Investigation of the capabilities of these tools by the example of hypothetical model industrial enterprises created a theoretical base (foundation) for constructive criticism of the so-called resource and factor approaches to measuring the potential and showed their scientific untenability by applying numerical examples [27–31]. Creating the scientific ground for the perspective directions of the constructive use of evaluations of potentials in management tasks was another important result of these studies [32, 33].

A striking contrast in methodology, methods and main results of the investigations of this group of scientists, considered on the background of widespread perceptions in economics, makes the scientific consideration of this phenomenon and causes of its emergence relevant.

**Objectives of the article.** Taking the foregoing into account, the main objective of the article is to show capabilities and productivity of applying the analogues of the axiomatic approach to constructing badly-formalized theories by an example of Economic Theory of Potentials, which allow us to construct an internally consistent system of views concerning basic points of the theory, including the systematization of potentials of economic entities, analysis and measurement of potentials, as well as of using their evaluations as a tool for strategic managing the corresponding economic entities.

**Statement of basic material of research.** It is known that the axiomatic method (axiomatic approach) represents one of the methods of constructing scientific theories, where some points of the theory are postulated as prime axioms, and other points (of a theorem) are logically deduced from them by means of certain rules (proofs). The axiomatic method requires a high level of development (formalization) of a theory to be axiomatized, therefore, it has found the widest application in mathematics, logic, certain sections of physics, biology, etc.

Economic Theory of Potentials is only in the initial stage of its development. As in case of economic theory in general, its complete axiomatization is not yet possible. At the same time, complying with the basic principle of the axiomatic method while constructing the theory of potentials may help to raise the level of unambiguity of the basic notions [concepts] and assertions of the theory, as well as definiteness of tasks and methods of solving its relevant questions, which creates the necessary conditions for further axiomatization of the theory. In this research paper, this approach is called “quasi-axiomatic” to emphasize the fact that, unlike the axiomatic method based on strict formal rules of deduction (proofs), the quasi-axiomatic approach is based on standard methods of justification used in economics and logic. In compliance with this approach, each next step in constructing the theory is a logical consequence of the previous ones.

Economic Theory of Potentials, as any other scientific theory, is a set of generalized scientific propositions, which give a comprehensive view of a certain sector of reality. The object of Theory of Economic Potentials is potentials of economic systems as a specific set of properties and relations taken [considered] in diversity of all their manifestations and interrelations. As a branch of economic science, Economic Theory of Potentials needs to give a description of the object under study, mechanisms of its organization and functioning, as well as to propose tools to manage potentials, including tools for observation, analysis, forecasting, planning and management proper in a narrow sense.

As follows from the above, in compliance with the quasi-axiomatic approach, the first thing to consider is a clear definition of the object and the subject of the theory.

The analysis of economic literature on Theory of Potentials allows to identify the whole range of basic questions attracting attention of economic scientists. It should also be noted that all of them quite logically result from the tasks of development of this theory.

**The notion of potential.** The basis of any theory is constituted by a system of its key notions and terms. In case of Economic Theory of Potentials, the key notion is the notion of potential. It is not surprising that in the

branch of economic science which is only taking its first steps, there is no unanimity of views on the meaning of this notion among scholars, and the existing formulations of its definition do not always comply with basic requirements for defining scientific notions [10, 34–39]. To cite an example, it is noted in [1, 10] that one can find in the economic literature definitions of potential as a set of resources necessary for conducting a certain activity; as a set of material and non-material assets the enterprise has which are used in the course of this activity; as the critical mass of resources of the economic entity necessary and sufficient for its innovative development (in case of innovative potential); as a set of factors and conditions for conducting a certain activity; as a set of resources, factors and conditions for this activity; as capabilities and a resource of the enterprise to carry out a certain activity (6); as a capability and readiness to implement the innovation process (for innovative potential); as a unity of capabilities the enterprise has to conduct an activity, internal and external factors of this activity; as a level of readiness of the enterprise to solve certain tasks; and many other definitions.

This diversity of opinions shows the relevance of studies aimed at giving a more precise definition of the meaning of the notion of potential in economics and of a strictly scientific formulation of its definition. The investigation of this question resulted in the following definition of the notion [11–13].

**The potential in economics** is a capability of *the economic entity* to carry out its immanently inherent *activity*, which characterizes *the maximum possible cumulative result* of this activity.

This definition was the result of the analysis of the notion of potential used in different sciences, such as physics, mechanics, biology, ecology, and others, as well as a correct (with regard for the specific features of economic systems) transposition of the standard explanation of potential in mechanics into the economic environment.

The fundamental feature of the foregoing definition of potential in economics is that the potential is defined as one of *synthetic signs* of economic entities and, namely, as a certain *capability* to carry out a certain activity. This formulation immediately requires the necessity of addressing the question of what objects can be potential holders. Despite the fact that this definition already contains a direct reference to the solution of this question, the question of potential holders has been practically overlooked by economic scientists and remained uninvestigated until recently (see. the article by I.N. Karapeychik [40]).

**Potential holders.** As it is noted in the article [39], the notion of potential is currently applied to almost any object. In [40], there is a detailed analysis of the causes of this situation, the main causes being the identification of potential with factors that determine the potential; uncritical use in the economic theory terms and notions of everyday life and other spheres of human activity; confusion of the notion of potential as an independent scientific category with arbitrary limiting characteristics of objects, processes and phenomena. The main result of this study is the justification of the appropriateness of considering solely economic entities as potential holders.

Defining the potential as a specific capability of economic systems (economic entities) immediately makes actual investigating the interdependence of this sign and other single-level synthetic signs of these systems. Research papers of this type are exemplified by [3, 7, 41–43], where the authors study the correlation between the notions of potential and competitiveness of enterprises and other related notions.

**Classification of potentials.** In any science, the classification of objects is both the result of development of the science, and a tool for its further development. It is regrettable that the economic literature provides many examples of constructs which are eclectic, inconsistent, insufficiently justified, lacking substance and nonconstructive for application (see, in particular, examples from the review [16, 21]).

Since economics is the science of management, the systematization of potentials needs to comply with the management tasks. As it follows from the general economic conceptions, as well as immediately from the definition of potential in economics, the following signs should be taken as the main classification criteria for potentials:

- signs of classification of economic entities (*the potential is a sign of any given economic entity*);
- signs of classification of activity categories (the potential characterizes the result of a certain activity of the economic entity);
- signs of classification of factors involved (*factors affecting the possible result of a certain activity conducted by a business entity*).

A section of one possible variant of a potential hierarchy with regard to activity categories, which is consequent on these conceptions, is shown in Fig. 1.

It is obvious that the general classification of potentials needs to be a combined classification with regard to all major signs, the dominant one being the sign of economic entity. Next in importance is the sign of activity category, and the factor sign is dependent on the first two [15, 21].

It is also evident that there can be many content classifications, since for each of different management tasks there are its own requirements as to the presentation of the subject area, the choice of additional classification signs and the classifications of all the signs themselves, in response to which the economic science proposes various content classifications (of economic entities, activity categories, factors determining the results of these activities, etc.).

This approach to the classification of potentials provides an internally consistent systematization of different types of potentials, and makes it possible to take a new view of the placement of different potentials within the framework of this systematization. To cite an example, such potentials as resource and personnel ones are factor potentials characterizing the highest possible results of the corresponding activity of a certain business entity conditioned by the possible states of precisely these factors.

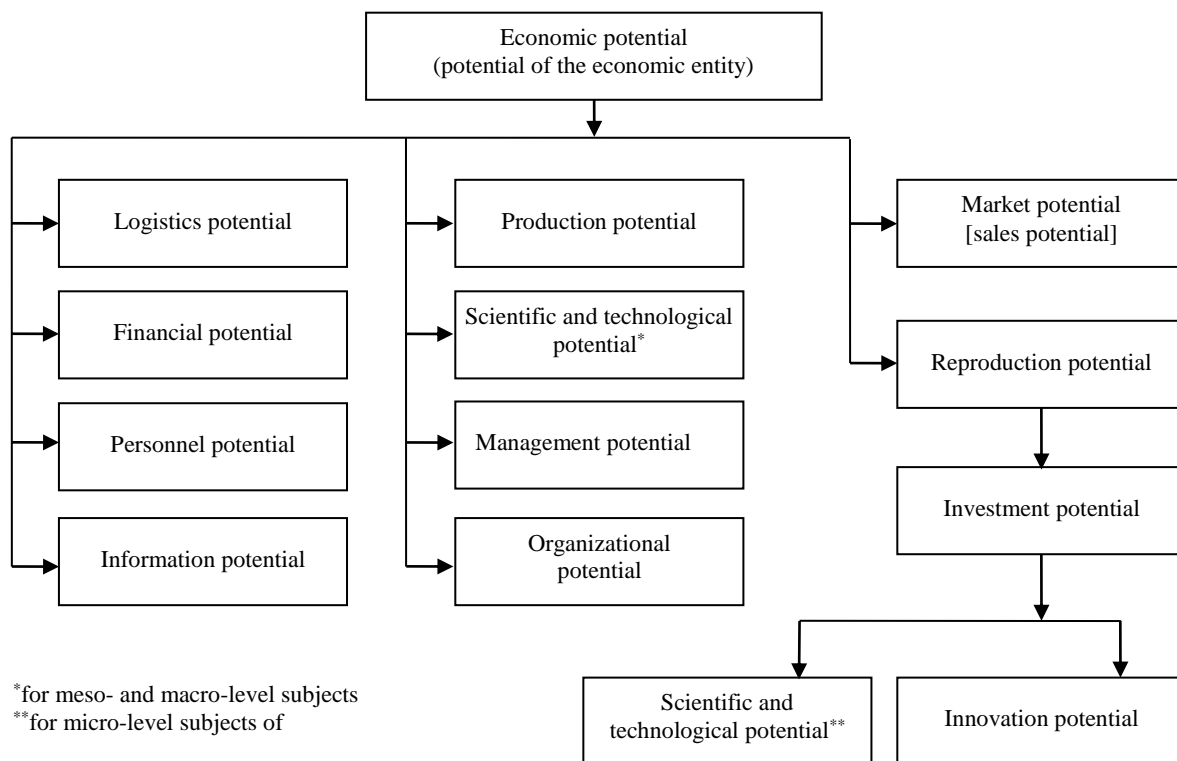


Fig. 1. Hierarchy of potentials of the economic entity (with regard to the industrial enterprise) [15]

**Evaluation [assessment] of potentials.** To manage (in a broad sense) the potential as some synthetic property of a particular economic entity, it is necessary to be able to measure the level of manifestation of this property. To solve this task, it is required to:

- introduce into scientific use the notion of evaluation of the potential of the economic entity;
- study the potential as an object of evaluation and develop, on this basis, the methodology for these evaluations;
- work out, in the framework of the accepted methodology, methods of evaluating potentials.

In order to manage the potential of the enterprise, it is necessary to know, in addition to the evaluation of the level of the potential, the whole set of factors that affect or could affect the value of the potential. From the foregoing definition of potential in economics, it follows that these are the factors determining the actual results of the activity conducted by economic entities. Since this question is the subject of a separate economic science – economic analysis, it is of no independent significance as an object of study in the framework of the theory of potentials. At the same time, it is hard to overestimate the importance of the relevant knowledge to the theory of potentials. Besides, unresolved questions such as the assessment of the combined actual results of various categories of activity (e.g. scientific and technological, investment and innovative, and many others [1, 44–47]) complicate greatly the solution of the task of evaluating potentials of certain types taken separately.

**Peculiarities of potential as an object of measurement.** The analysis of the economic character of potentials and similar signs (see. in particular [1, 3, 4, 8, 41]) made it possible to reveal the following peculiarities of potentials as an object of assessment and their evaluations:

- the potential (similar to an arbitrary capability) – is a latent sign, i.e. it is not a directly observable and measurable feature of a certain object;
- the potential characterizes prospective results of the activity, i.e., it has a prognostic character, and its evaluations are, to a certain extent, future projections of these results.
- the value of the potential is affected by the current state of the potential holder and the future state (state forecast) of the external environment, i.e., evaluations of the potential are conditional, depending on these factors and conditions;
- units of measurement of potentials are units of measurement of the results of the relevant activity (this follows directly from the definition of potential as a feature characterizing certain results of the activity).

**Methodological aspects of measuring potentials.** The foregoing properties of potentials and requirements to their evaluations determine theoretically possible methodological approaches to potentials. These could be approaches implementing the idea of *indirect* measurements based on the analysis of:

- the actual manifestations of the sign to be measured;
- the state of factors determining the value of the potential;
- directly observable signs closely interrelated with the potential.

Theoretically possible indirect methods for measuring potential should also include combined approaches representing an arbitrary combination of the three approaches stated above.

Unlike the approaches presented above, the systematic approach to measuring the latent signs, which involves constructing a model of the object – the holder of this sign, can be regarded as a *quasidirect* method of measurements, as it provides direct observation and measurement of the model of the sign being evaluated rather than of the object itself.

A weak point of all indirect methods of measuring potentials is the need for accepting a hypotheses concerning the interrelations of the value of the signs which are measured directly and the value of the potential. In the first of the cases examined, it is assumed that the higher the actual results of the activity whose potential is being evaluated are, the higher the potential itself is, i.e., the best possible result. In the second case, similarly to the first, it is suggested that the better the aggregate state of the factors determining the level of the potential is, the higher the level of the potential itself is. The third case, as applied to economics, is purely hypothetical, since identifying the relations between observable and unobservable synthetic economic signs constitutes a task which is no less difficult than the task of measuring the latent signs themselves.

Studies show (see., e.g., [3, 6, 30, 31, 48]) that the foregoing assumptions are insufficiently justified and can cause significant distortions in the evaluations of the potential, as the object of evaluation is actually replaced by other objects (actual manifestations of the potential and relevant factors) and the evaluations of the potential are substituted by the evaluations of the actual results of activities of the potential holder (a classical problem of the economic analysis) or by generalized evaluations of a combination of factors.

The systematic approach doesn't have these shortcomings, however, it involves difficulties related to limited capabilities of present-day economic and mathematical theory concerning description of economic entities, phenomena and processes. Nevertheless, this approach is, in our opinion, the most promising and follows directly from the character of potentials and the conception of potentials taken in this study. Let us consider the main provisions of the system approach, directly resulting from theoretical judgments stated above.

**Quantitative analysis of the potential of the enterprise.** Before proceeding to the description of the algorithm of the quantitative assessment of the potential which logically results from the conception of potentials taken by the authors of this study and implements the systematic approach to measuring potentials, let us point out the key notion of the proposed approach – the *potential function*, which is understood as the dependence of the potential's value on the external environmental factors [3, 21].

The notion of the potential function is a logical consequence of the definition of the potential as the maximum possible result of the economic entity's activity and of the potential's specific character as an object of measurement – dependence of the level of the potential on possible conditions of the external environment.

All of the preceding means that the task of quantitative evaluation of the potential is actually nothing but the task of forming and analyzing the relevant potential function. The form of defining the potential function  $U$ , in turn, determines the methods of analysis. In the framework of the conception [concept] under consideration, these are optimization methods under uncertainty [5, 49–52] and various methods of multivariate statistical analysis.

The general solution algorithm is determined by the character of this optimization task and the possibilities of its analysis and, as applied to the task of evaluating the economic potential of the enterprise, its viability and competitiveness, and has the following form [4, 17, 21, 22, 25].

1. Construction of the economic-mathematical model of the enterprise.
2. Mathematical formulation of the task of maximizing the net income of the enterprise on the basis of its mathematical model.
3. Formation of the “uncertainty zone” of the exogenous parameters of the task (the domain of the potential function  $U$ ).
4. Tabulation of the potential function  $U$  of the enterprise (by applying the method of statistical tests for probing the “uncertainty zone” of the parameters of the above-noted task by solving it with sets of parameters from the domain of the potential function  $U$  determined in a random manner (identifying the “uncertainty zone” of solutions (range of values) of the given function).
5. The analysis of the properties of the potential function  $U$  of the enterprise (by applying the methods of multivariate statistical analysis: methods of ranking, grouping, classification, correlation, regression and factor analysis). The idea of this method will be illustrated with the following conceptual ideas regarding the model of the industrial enterprise (Fig. 2) and its potential function – the economic potential, as described in [22].

**Conceptual mathematical model of the enterprise's potential.**

The potential  $U$  (at some fixed instant of time) of the enterprise in the state  $S$  operating in the external environment that has the impact  $X$  on the enterprise (i.e. the potential of the enterprise, operating in the environment characterized by the parameters  $X$ ), can be determined as follows:  $U = \max_v R(S', Y)$ ,  $S' = \Psi_S(X, S)$ ,  $Y = \Psi_Y(X, S)$ .

$U$  – the potential of the enterprise;

$v$  – a set of values of the controlling parameters,  $v \in V$ ,  $V \subset S$ ;

$S, S'$  – the state of the enterprise at the beginning and at the end of one production cycle;

$\Psi_S, \Psi_Y$  – the functions of states and outputs of the automaton, respectively;  
 $R$  – the indicator characterizing the result of the activity of the enterprise (in the model shown below – the indicator of net income (net profit)).

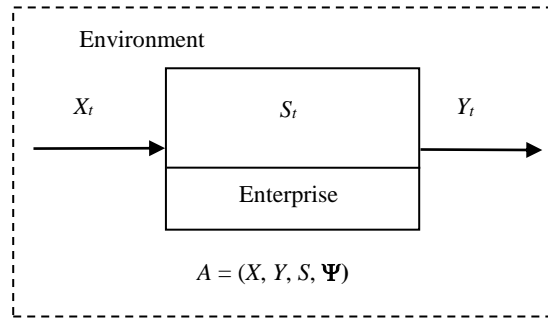


Fig. 2. Automaton model of the industrial enterprise [22]

$A$  – the automaton [conceptual machine] (the model of the enterprise);  $X$  – the set of inputs of the automaton;  $S$  – the set of states of the automaton;  $Y$  – the set of outputs;  $\Psi$  – the rearrangement [transformation] of the set  $X \times S$  into the set  $X \times S$ .

**Basic ratios of the conceptual model of the industrial enterprise.**

The production functions (technologies):  $q_i = A_i \cdot K_i^{\alpha_{Ki}} \cdot L_i^{\alpha_{Li}} \cdot R_i^{\alpha_{Ri}}$ .

The gross income  $Q$ :  $Q = q \cdot c_q$ .

The cost of material resources:  $r_{ij} = a_{ij} \cdot R_i \quad \forall i, j, i \in I, j \in J; r_j = \sum_i r_{ij}$ .

The gross expenditures  $C$ :  $C = \sum_j c_{rj} \cdot r_j + \sum_i (1 + \delta_L) \cdot c_L \cdot L_{i+} + c_0$ .

The gross profit  $P_g$  and the net profit  $P_n$  of the enterprise:

$$P_g = Q - C - \delta_K \cdot \sum_i K_i; P_n = \begin{cases} P_g, & P_g \leq 0 \\ (1 - \delta_P) \cdot P_g, & > P_g \end{cases}$$

The restrictions with the demand imposes on the supply of resources and production volumes:

$$\sum_i K_i \leq K_0, \quad \sum_i L_i \leq L_0, \quad r_j \leq r'_j \quad \forall j, j \in J;$$

$$q_i \leq Q_i \quad \forall i, i \in I; K \geq 0, L \geq 0, R \geq 0$$

The economic potential of the enterprise  $U$ :  $U = \max_v P_n$ ;  $v \in \{K_i\} \cup \{L_i\} \cup \{r_{ij}\} \quad \forall i, j$ .

$I$  – the index set of technologies available to the enterprise,  $I = \{1, \dots, n\}$ ,  $n$  – the number of technologies;

$J$  – the index set of types of resources used in manufacturing products,  $J = \{1, \dots, m\}$ ,  $m$  – the number of types of resources.

The endogenous parameters (the parameters of the enterprise):

$A_i, \alpha_{Ki}, \alpha_{Li}, \alpha_{Ri}$  – the parameters of the production function  $i$ ;

$a_{ij}$  – the rate of consumption of the resource  $j$  in manufacturing the product  $i$  ( $a_{i1} : a_{i2} : \dots : a_{im}$  – the ratio of resources of all types in a single set of resources for manufacturing the product  $i$ );

$R_i$  – the number of sets of resources used for manufacturing the product (in conformity with the technology) of type  $i$ ;

$r_{ij}$  – the expenditures of the resource of type  $j$  in manufacturing the product  $i$ ;

$c_0$  – the semi-fixed costs.

$K_0$  – the value of the fixed assets of the enterprise;

$K_i$  – the fixed assets of the enterprise used in conformity with the technology  $i$ ;

$L_0$  – the labour resources of the enterprise;

$L_i$  – the labour resources used in conformity with the technology  $i$ .

The exogenous parameters (the parameters of the external environment),  $X$ :

$Q_i$  – the market demand for the product of type  $i$ ;

$r'_j$  – the market supply of the resource of type  $j$ ;

$c_{qi}$  – the price of the products of type  $i$ ;

- $c_{rj}$  – the price of the resource of type  $j$ ;
- $c_q$  – the vector of prices for the products of the enterprise;
- $c_L$  – the “cost” of labor resources;
- $\delta_L$  – the rate of dues and charges proportional to wages fund;
- $\delta_K$  – the depreciation rate of the fixed capital;
- $\delta_p$  – the income tax rate.

Rather strict assumptions of this relatively simple model of the enterprise are evident from the mathematical ratios stated above, yet they do not limit in the least the possibilities of demonstrating the basic methodological provisions of measuring potentials.

One can readily see from the above that the economic potential of the enterprise is nothing else than a large number of solutions of the optimization task (1)–(7) – the optimum values of the  $P_n$  for all possible combinations of the external parameters  $X$ , whereas the potential function of the enterprise is the dependence of these optimal values on the parameters of the external environment.

**Analysis of the potential function of the model enterprise.**

The construction and analysis of the potential function is executed by using the model of the enterprise as an example. The parameters are shown in Table. 1.

Table 1

**The parameters of the numerical model of the enterprise [22]**

Parameters of the external environment, $X$	Value	Parameters of the enterprise, $S$	Value
$c_{r1}; c_{r2}$	1; 2	$n; m$	2; 2
$c_{q1}; c_{q2}; c_L$	5; 3; 1	$a_{11}; a_{12}$	1; 2
$r'_1; r'_2$	100; 75	$a_{21}; a_{22}$	3; 1
$Q_1$	50	$A_1; A_2$	5; 4
$Q_2$	40	$\alpha_{K1}, \alpha_{L1}, \alpha_{R1}$	0,3; 0,2; 0,4
$\delta_L$	0,30	$\alpha_{K2}, \alpha_{L2}, \alpha_{R2}$	0,3; 0,5; 0,2
$\delta_p$	0,15	$K; L; c_0$	100; 50; 50

The tasks of the type (1)–(7) with fixed parameters belong to the class of non-linear programming tasks, the analytical solution of which is generally impossible. However, there exist effective quantitative methods for the solution of tasks of this type. From this it follows that the construction of the potential function of the enterprise  $U$  is possible only through its tabulation, which can be done by solving the stated optimization problem for all possible combinations of values of the exogenous parameters. One of the most applicable methods for tabulating the function  $U$  is the method of statistical test [4, 5, 17, 22, 25, 53].

When the model (1)–(7) was under study, for each  $k$ -th exogenous parameters  $x_k, x_k \in \mathbf{X} \forall k$ , the range of possible values was fixed in the form of the segment  $[x'_k - \Delta x_k, x'_k + \Delta x_k]$ , where  $\Delta x_k = \gamma \cdot x'_k, x'_k$  – the center of the range of possible values of the  $k$ -th parameter of the external environment in Table. 1, with  $\gamma = 20\%$  [22].

Since the tabulation of the potential function  $U$  results in the graph of this function ( $U, X$ ), representing a statistical sample of the dimension  $k+1$ , where  $k$  is the number of the exogenous parameters  $X$ , the only possible methods of analyzing the potential function are methods of multivariate statistical analysis. In a series of research papers on the subject, the authors provide examples of the application of descriptive statistics, correlation, regression and cluster analysis, and multidimensional scaling techniques [3, 4, 5, 17, 22, 24, 25, 26, 48].

Table 2

**Descriptive statistics of the sample values of the endogenous parameters and the economic potential [22]**

	$U$	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$	$A_1$	$A_2$	$\alpha_{K1}$
Mean	214,95	1,01	2,00	3,02	1,00	4,95	4,01	0,30
Minimum	166,28	0,80	1,60	2,41	0,80	4,00	3,20	0,24
Maximum	241,86	1,20	2,40	3,60	1,20	5,99	4,79	0,36
Standard Error	0,99	0,01	0,02	0,02	0,01	0,04	0,03	0,00
Constant of Variation	0,065	0,116	0,115	0,116	0,115	0,118	0,119	0,111
	$\alpha_{L1}$	$\alpha_{R1}$	$\alpha_{K2}$	$\alpha_{L2}$	$\alpha_{R2}$	$K_0$	$L_0$	$c_0$
Mean	0,20	0,40	0,30	0,51	0,20	100,43	49,48	50,41
Minimum	0,16	0,32	0,24	0,40	0,16	80,02	40,19	40,12
Maximum	0,24	0,48	0,36	0,60	0,24	119,99	59,53	59,88
Standard Error	0,00	0,00	0,00	0,00	0,00	0,85	0,41	0,42
Constant of Variation	0,117	0,114	0,123	0,114	0,115	0,120	0,117	0,119

Below are the main results of the similar analysis with regard to the model under consideration, which were borrowed from [22]. It should be noted that the authors of this research paper employed a broad interpretation of the potential function of the enterprise, which, in contrast to the standard one, involves considering as arguments, along with the exogenous parameters, the endogenous parameters, i.e. the parameters characterizing the state of the enterprise. The feasibility of this interpretation of the potential of the enterprise is determined by the relevance of management tasks that can be solved by using evaluations of potentials, and will be demonstrated in the discussion of the quantitative analysis results below.

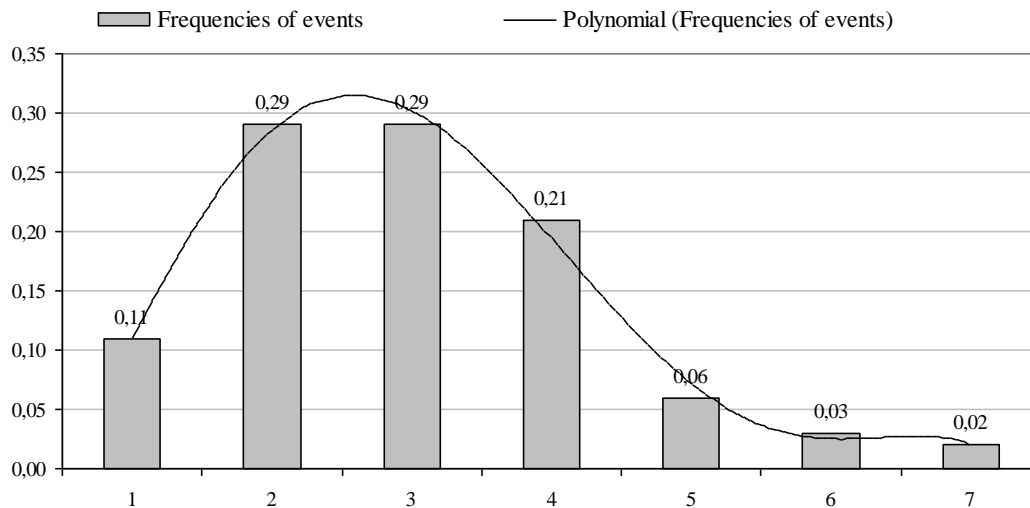
Basic descriptive statistics of the statistical multitude – the potential function graphics – are shown in Tables 2 and 3.

Table 3

**Descriptive statistics of the sample values of the exogenous parameters and the economic potential [22]**

	$c_{r1}$	$c_{r2}$	$c_{q1}$	$c_{q2}$	$c_L$	$r'_1$
Mean	0,99	1,98	5,02	2,99	1,00	100,86
Minimum	0,80	1,61	4,01	2,40	0,80	80,47
Maximum	1,19	2,40	5,98	3,60	1,20	119,79
Standard Error	0,01	0,02	0,04	0,03	0,01	0,75
Constant of Variation	0,12	0,12	0,12	0,12	0,11	0,11
	$r'_2$	$Q_1$	$Q_2$	$\delta_L$	$\delta_p$	$U$
Mean	75,36	49,98	39,53	0,30	0,12	220,15
Minimum	60,16	40,04	32,06	0,24	0,12	135,76
Maximum	89,79	59,81	47,93	0,36	0,18	310,22
Standard Error	0,62	0,42	0,32	0,00	0,00	2,52
Constant of Variation	0,12	0,12	0,11	0,12	0,11	0,16

In these tables, particular interest is attracted by the lines with the values of the coefficient of variation, which indicate that the variability of the value of the economic potential is much lower than the variability of each individual factor. Roughly the same level of variability of the endogenous and the exogenous parameters is evident, since the sample values of these parameters was obtained in accordance with the uniform distribution law. As to the level of variability of the potential, it reflects the value of the combined (systemic) effect of the variability of these factors. On the content level, this effect can be explained as follows. Since the behavior of the enterprise is target (optimal in compliance with the model of the enterprise (1)–(7)), the company manages to minimize the negative impact of certain [the corresponding] combinations of the conditions. This point is confirmed, among other things, by the distribution of the value of the economic potential (see Fig. 3).



**Fig. 3. The distribution of frequencies of events of the value of the economic potential [22]**

In this Figure, the clusters are arranged on the abscissa axis in descending order of the level of the potential, and it is quite evident that, in spite of the uniform distribution of the model parameters, the law of distribution of the economic potential is not subject to the uniform distribution law. More detailed studies by some scientists [3–5, 22, 24–26, 30, 48, 54] indicate that the resulting distribution can vary from enterprise (depending on the endogenous model parameters), and the potential function of the enterprise itself can be described by using models of distribution of random values.

The application of the correlation and regression analysis makes it possible to reveal certain connections between the level of the potential of the enterprise and the factors accounted for in the model of the enterprise.



Tables 4 and 5 show the parameters of regression models relating to the dependence of the value of the potential on the endogenous and the exogenous factors, respectively.

Table 4

**The parameters of regressive dependence of the economic potential on the endogenous parameters [22]**

	b*	Std.Err. of b*	b	Std.Err. of b	t	p-value
Intercept			12,002	7,080	1,695	0,092
$\alpha_{K1}$	0,463	0,017	197,111	7,242	27,219	0,000
$c_0$	-0,391	0,017	-0,910	0,039	-23,134	0,000
$A_1$	0,388	0,017	9,257	0,416	22,233	0,000
$\alpha_{L2}$	0,329	0,017	79,427	4,096	19,391	0,000
$A_2$	0,266	0,017	7,814	0,499	15,665	0,000
$\alpha_{R1}$	0,263	0,017	80,928	5,210	15,532	0,000
$\alpha_{K2}$	0,254	0,017	96,747	6,640	14,569	0,000
$\alpha_{L1}$	0,185	0,017	110,838	10,437	10,620	0,000
$a_{21}$	-0,117	0,017	-4,643	0,687	-6,758	0,000
$K_0$	0,111	0,017	0,129	0,020	6,512	0,000
$a_{11}$	-0,041	0,017	-4,931	2,082	-2,369	0,019
$a_{12}$	-0,034	0,017	-2,034	1,030	-1,975	0,050

Table 5

**The parameters of the regressive model of the economic potential on the external environment parameters [22]**

	b*	Std.Err. of b*	b	Std.Err. of b	t	p-level
Intercept			-291,534	6,532	-44,629	0,000
$c_{r1}$	-0,054	0,008	-16,985	2,499	-6,798	0,000
$c_{r2}$	-0,032	0,008	-4,711	1,202	-3,919	0,000
$c_{q1}$	0,704	0,008	43,168	0,485	88,932	0,000
$c_{q2}$	0,322	0,008	33,057	0,819	40,369	0,000
$c_L$	-0,058	0,008	-18,547	2,586	-7,172	0,000
$Q_1$	0,574	0,008	3,460	0,048	72,471	0,000
$Q_2$	0,249	0,008	1,977	0,063	31,300	0,000
$\delta_p$	-0,097	0,008	-68,640	5,768	-11,900	0,000

The data in these tables show that the coefficients in the column b\*, which can be interpreted as the contribution of each factor to the formation of values of the independent variable (in this case, the economic potential), vary from factor to factor. In case of the joint impact of all factors, the role of some factors in the formation of the potential value is greater than the role of others. However, this means that the enterprise, on the average, is more responsive to changes in certain factors and is less susceptible to changes in others. Moreover, this regularity holds true for favorable as well as negative changes in various factors. All of this made it expedient to introduce the notion of critical factors [22, 25] and to divide, on the basis of the results of statistical analysis of the potential functions, all the factors into critical and non-critical.

The existence of this regularity sheds some light on how and in which management tasks evaluations of potentials can be used, on the role of the economic theory of potentials in the system of economic sciences.

Let us consider the main consequences for the theory of management of potentials in economics, which follow from the results of investigations of this type made at the enterprise level.

**Potentials and strategic management of development of enterprises.** The knowledge of the level of the potential of enterprises, i.e. the maximum possible results of their activity under all possible external operating conditions, is essential for managing the *development* of enterprises. Any process of development of any economic system can be represented as a twofold process: moving from the current actual state to the maximum possible capabilities and expanding the maximum possible capabilities.

If the maximum possible capabilities in forecasted conditions do not comply with the requirements of the owners of the enterprise or of its senior management, it means that there is a problem and it serves as a classical reason for setting the task of restructuring the enterprise.

Thus, the analysis of the potential function of the enterprise may serve as a tool for *identification and clarification of the problems concerning the development of the enterprise* [32].

Under the assumption that the existence of this problem has been set, the multivariate statistical analysis of a sample function of the enterprise allows us to identify “bottlenecks” in the enterprise and the most promising directions of its development, i.e., to serve as one of the tools for *goal-setting* and for selection of the objectives of restructuring [32, 33].

Let us illustrate this by the example of the data in Table 5. The critical factors in this table are indicated in bold. Among these, the greatest impact on the value of the economic potential is provided by such external

environment parameters as the demand  $Q_1$  and the price  $c_{q1}$  for the product of the first type and, to a lesser extent, the demand for the product and the price of the second type ( $Q_2, c_{q2}$ ). This means that the enterprise is the least resistant to the unfavourable changes in these factors and the most responsive to the favourable changes in these factors. Consequently, the primary task (the development objectives) is to neutralize the negative affect of these factors and to change the state of these factors in the direction favourable for the enterprise. As is well known, it is possible to attain this objective in different ways: by working with the consumers of the product (in the field of contractual relations), by improving the quality of the product and by its support with the consumer, by accessing to new markets, etc.

In contrast to the critical factors, changes in other exogenous parameters (see., e.g., the prices of the resources consumed by the enterprise  $c_{r1}, c_{r2}, c_L$ ) have little effect on the value of the economic potential, which makes it inexpedient to set the corresponding objectives and to consider measures aimed at reducing the prices for consumed resources, decreasing the volumes of these resources, reducing the resource-intensiveness of the products on the whole, etc.

Let us now consider the impact of the endogenous factors on the level of the economic potential (Table 4). Changes in the values of these parameters mean changes in the state of the enterprise, and improvement of the values of these parameters can be viewed as the development of the enterprise resulting from implementing the corresponding measures (for example, within the framework of the restructuring of the enterprise). From this table we notice that the most critical parameters are such parameters as dependence of the elasticity of production on the values of fixed capital  $\alpha_{K1}$  and labor resources  $\alpha_{L2}$ , the scale coefficient  $A_1$  of the technology 1 and the indirect expenses  $c_0$ . Consequently, in case of this enterprise, the most expedient measures to be implemented are the ones aimed at improving the efficiency of the first technology in general and the way the fixed capital and the labor are used in it, as well as at reducing indirect expenses of the enterprise.

**Conclusions.** The axiomatic method of constructing scientific theories is an effective tool for providing internal consistency of the theories to be axiomatized, however, it requires a fairly high level of formalization of the main provisions of these theories. The economic theory of potentials belongs to relatively new fields of economics, provides many examples of postulates and approaches which are in poor agreement with each other, and does not comply with the specified requirements. However, the fact that the theory of potentials is at the initial stage of development makes the attempts to construct it and develop in compliance with the principles similar to those of the axiomatic method especially relevant.

The quasi-axiomatic approach proposed in this article is built upon the basic principle of the axiomatic method, which provides for identifying the basic, prime assertions of the theory and constructing the theory around deduction of all other derived assertions from the prime postulates. However, in contrast to the axiomatic method, the prime assumptions, as well as the inference rules, are based on generally accepted economic methods of justification (proof) and economic logic. In addition to the prime assumptions and consequences which are logically deduced from them, the issues (tasks) of economics of potentials to be investigated, the selection of methods of studying (solving) these tasks and the choice of directions and ways of application, in theory and in practice, of the results obtained by the use of all these tools, should also be subject to this justification.

In the variant of the economic theory of potentials analyzed by the authors of this research, the basic element that predetermines the whole logic of constructing the theory and its structure is the notion of potential, defined as the ability of the economic entity characterizing the highest possible result of its activity under different conditions of the external economic environment. This interpretation of the notion of potential in economics logically results in content classifications of all sorts of types of potentials, methodology and methodological approaches to evaluating the level of potentials, specific possibilities of using evaluations of potentials in management tasks, as well as issues requiring further study. The most relevant of them are the problem of identifying and measuring the cumulative results of activities of different categories (scientific and technological, innovative, and others) and the improvement of economic and mathematical tools for modeling and analysis of potentials.

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Надіслана/Written: 28.07.2015 р.  
Надійшла/Received: 30.07.2015 р.  
Рецензент: д.е.н., проф. О. О. Орлов