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РОССИЙСКИЙ ИНДЕКС НАУЧНОГО ЦИТИРОВАНИЯ
Science Index

Submitted for review in

Conference Proceedings Citation Index - Social Sciences & Humanities (CPCI-SSH)

THOMSON REUTERS

Verlag SWG imex GmbH
Nürnberg, Deutschland,
2017

Verlag SWG imex GmbH

SCIENCE AND EDUCATION

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Science and education: Collection of scientific articles. - Verlag SWG imex GmbH, Nürnberg, Deutschland, 2017. - 396 p.

ISBN 978-3-9819288-4-6

Collection of scientific articles published the scientific and practical publication, which contains scientific articles of students, graduate students, Candidates and Doctors of Sciences, research workers and practitioners from Europe, Russia, Ukraine and from others coutries and beyond. The articles contain the study, reflecting the processes and changes in the structure of modern economy and state structure. The collection of scientific articles is for students, postgraduate students, doctoral candidates, teachers, researchers, practitioners and people interested in the trends of modern economic science development.

ISBN 978-3-9819288-4-6

9. MATHEMATICAL METHODS IN ECONOMY

Azarova A. O.,
PhD, Professor
Moroz O.V.,
Doctor of economic science, Professor
Zhalin Y. O.
Vinnytsia National Technical University, Vinnytsia

THE MATHEMATICAL MODEL OF ENTERPRISES INNOVATION ATTRACTIVENESS ON THE BASIS OF FUZZY LOGIC THEORY

Abstract.*The mathematical model of enterprises innovation attractiveness on the basic of fuzzy logic theory is proposed in the article.*

Key words: *innovation attractiveness, fuzzy logic, innovative attractiveness, fuzzy logic, matrix of knowledge, mathematical model.*

INTRODUCTION

In conditions of modern development of market relations an important indicator of the efficiency of enterprises production, increasing its competitiveness, ensuring the stable growth of subjects of different forms of ownership and management is the automation of the processes of enterprise innovation attractiveness (IAE) management by means of mathematical modeling.

Problems of innovative attractiveness were studied in the fundamental works of such domestic and foreign scientists as R. Akof, O. Bakayev, N. E. Boytsun, M. P. Buslenko, V. V. Vitlinsky, S. G. Diordits, F. Emmer, P. Whitfield, P. Drucker, M. A. Kizim, T. S. Klebanova, V. F. Kovalchuk, N. I. Kostyna, Y. G. Lysenko, A. M. Mariuta, A. Galchinsky, B. Grinev, O. Lapko, V. F. Sitnik, M. I. Skrypnichenko, V. M. Tomashevsky and others. However, existing models and approaches of IAE level estimation are too limited, they do not take into account a wide range of different parameters of the external and internal environments influence and are poorly formalized.

Table 1

Components which have influence on the enterprise innovative attractiveness

Innovative attractiveness of the enterprise		
Enterprise infrastructure	Financial statement	Organizational characteristics
- industrial infrastructure; - innovation infrastructure; - information infrastructure; - social infrastructure.	- venture capital; - financial independence; - level of assets liquidity; - solvency level; - purposeful use of money; - external sources of financial activity financing; - high quality management at the enterprise.	- staff fluidity; - motivation; - labor discipline; - corporate culture; - productivity; - innovation infrastructure.

The aim of this work is to develop a mathematical model for estimating the level of enterprise innovative activity, which would allow for a clear formalization of

expert assessments, has a flexible structure and high adaptability, and takes into account all factors of influence.

To form the set of input parameters should be taken into account for estimating of enterprise innovation attractiveness level the components such as those in the table 1 [1].

In our model, as universal sets for the linguistic variables terms, we take ranges of possible values of the corresponding indicators of the estimation of IAE level.

The set L of the primary input indicators l_c $(c = \overline{1,C})$ makes possible to determine the set $X = \{x_{ij}\}$, $i = \overline{1,n}$, n=3, $j = \overline{1,L}$, J=17 of estimation parameters. In turn X is the basis for identifying the set of functions f_1 ... f_3, which make possible the estimation of enterprise innovation attractiveness by a set of output parameters $ID = (ID_k), k = \overline{1,K}, K = 3.$

Thus, the mathematical model of such a process is proposed by the authors like below [2]:

$$L \xrightarrow{F_1} X \xrightarrow{F_2} ID_k, F_1 : J \to X; F_2 = F(f_1, f_2, f_3),$$
$$f_1 = g_1(x_{11} \ldots x_{14}), f_2 = g_2(x_{21} \ldots x_{27}), f_3 = g_3(x_{31} \ldots x_{36}) \quad (1)$$

The set of input and output parameters, all the functions of aggregation in their consistent execution is described in the structural model of IAP estimation (fig. 1).

On the basis of estimation parameters x_{ij}, $i = \overline{1,3}$; $X_j = \overline{1,17}$ are formed the set of aggregation functions: f_1 – function of enterprise infrastructure; f_2 – function of the enterprise financial statement; f_3 – function of enterprise organizational characteristics.

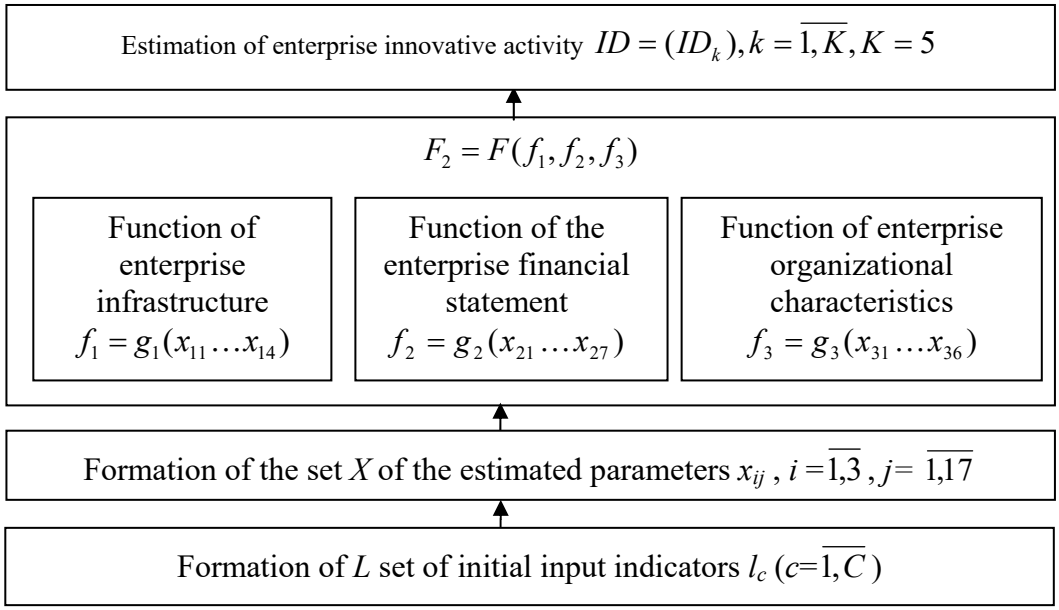

Figure 1. Structural model for IAE estimating

To evaluate the parameters $x_{11}, \ldots, x_{14}$, $x_{21}, \ldots, x_{27}$, $x_{31}, \ldots, x_{36}$ it is necessary to use three fuzzy terms $t = \overline{1,T}$, T=3, since they accurate take into account the specifics of the described parameters. Imagine the value of these indicators on a scale of "0-1".

On the basis of agreed (by the authors of the article) expert information was composed matrices of knowledge for the estimation of aggregation functions (f_1 – function of enterprise infrastructure; f_2 – function of the enterprise financial statement; f_3 – function of enterprise organizational characteristics). Let's illustrate, for example, the matrix of knowledge for enterprise infrastructure function (table 1) [3].

Table 1

The matrix of knowledge for estimating the level of functions f_1 – enterprise infrastructure

x_{11}	x_{12}	x_{13}	x_{14}	f_1
B	*B*	*B*	*B*	*B*
B	*B*	*C*	*B*	
C	*B*	*B*	*C*	*BC*
C	*C*	*B*	*B*	
C	*B*	*C*	*C*	*C*
C	*C*	*H*	*C*	
C	*C*	*C*	*C*	*HC*
H	*C*	*C*	*C*	
H	*C*	*H*	*H*	*H*
H	*H*	*H*	*H*	

On the basis of 3 knowledge matrices, the authors of the article have composed the logical equations for all aggregation functions. In particular, for f_1 such equations are as follows [4]:

$$\mu^B(f_1) = \mu^B(x_{11}) \cdot \mu^B(x_{12}) \cdot \mu^B(x_{13}) \cdot \mu^B(x_{14}) \vee \mu^B(x_{11}) \cdot \mu^B(x_{12}) \cdot \mu^C(x_{13}) \cdot \mu^B(x_{14});$$

$$\mu^{BC}(f_1) = \mu^C(x_{11}) \cdot \mu^B(x_{12}) \cdot \mu^B(x_{13}) \cdot \mu^C(x_{14}) \vee \mu^C(x_{11}) \cdot \mu^C(x_{12}) \cdot \mu^B(x_{13}) \cdot \mu^B(x_{14});$$

$$\mu^C(f_1) = \mu^C(x_{11}) \cdot \mu^B(x_{12}) \cdot \mu^C(x_{13}) \cdot \mu^C(x_{14}) \vee \mu^C(x_{11}) \cdot \mu^C(x_{12}) \cdot \mu^H(x_{13}) \cdot \mu^C(x_{14});$$

$$\mu^{HC}(f_1) = \mu^C(x_{11}) \cdot \mu^C(x_{12}) \cdot \mu^C(x_{13}) \cdot \mu^C(x_{14}) \vee \mu^H(x_{11}) \cdot \mu^C(x_{12}) \cdot \mu^C(x_{13}) \cdot \mu^C(x_{14});$$

$$\mu^H(f_1) = \mu^H(x_{11}) \cdot \mu^C(x_{12}) \cdot \mu^H(x_{13}) \cdot \mu^H(x_{14}) \vee \mu^H(x_{11}) \cdot \mu^H(x_{12}) \cdot \mu^H(x_{13}) \cdot \mu^H(x_{14}).$$

The main result of the research is working out of a mathematical model for estimating the level of IAE which based on the mathematical apparatus of the fuzzy logic theory. The advantage of the developed fuzzy model is that the connection between the input parameters and the output parameter is described with the help of natural language concepts that are objectively much more "closer" to expert analysts than abstract mathematical concepts. This ensures a high level of adequacy of composed mathematical model. Also, the developed model has a high ability to adaptation of expert data since it takes in to account a large number of parameters which can be optimized.

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Ivakhnenko O.V.,
Ph.D. in economics, Associate Professor
Simon Kuznets Kharkiv National University of Economics, Ukraine

ESTIMATION OF THE MINIMUM WAGE CHANGING EFFECT ON THE REGIONAL VARIATION OF WAGES IN UKRAINE

Abstract. *To assess the dynamics of changes in interregional variation in wages, analytical tools based on econometric models are presented. The analysis of the influence of seasonal factors and the general tendency of the increase in the level of labor remuneration on the change in the variation of wages is introduced. Results of conducted econometric analysis of the effect on the regional variation of labor payment in Ukraine of the minimum wage institute are provided.*
Keywords: *wages, minimum wage, minimum salary, uneven development, labor market, regional development differences, remuneration.*

Differences in wages in different regions of the country conduce "competitive" and "uncompetitive" labor markets appearance, reduce the attractiveness of territories for employment, provoke migration, discontent and social disturbance in society. Regional differences in wages require studying, timely measurement and management by the state, since they underlie further regional discrepancies due to the cyclical nature and self-organization of the market mechanism [1].

One of the direct methods for social inequality in wages regulation in Ukraine is the institution of minimum wage (MW). By changing the size of the minimum wage, the state influences labor incomes formation processes.

As of the beginning of 2017, 22 countries from 28 EU members (except Denmark, Italy, Cyprus, Austria, Finland and Sweden) had legally formalized MW [6].

However, the influence of the minimum wage institution on the formation of labor incomes has not been studied thoroughly. For example, in [7] it is proved that the MW instituion has a positive effect on the growth of wages and incomes of the population in the USA. At the same time, similar studies for the UK highlight the negative impact of MW on the market [8].

The current researches suggests that the situation with the appropriateness of applying MW is solely individual and depends on the country and period of its development. At the same time, the effect of MW on interregional wage differentiation can be studied separately, as a necessary part of the process of investigating the impact of MW on income formation of as a whole.

The purpose of the article is to develop the methodology for estimating the impact of the minimum wage institution on chang of the regional variation of the labor incomes.

Preliminary analysis made allowed to formulate the following basic

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Collection of scientific articles

Verlag SWG imex GmbH
Bärenschanzstr, 75
Nürnberg, Deutschland,
Telefon: +380688517552
E-Mail: swgimexgmbh@gmail.com

ISBN 978-3-9819288-4-6