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CONCENTRATION AND COMPETITION IN SERBIAN BANKING SECTOR

BUKVIĆ RAJKO M.
Geographical Institute "Jovan Cvijić" SASA, Belgrade, Serbia
Nizhny Novgorod State University of Engineering and Economics, Knyaginino, Russia
e-mail: r.bukvic@mail.ru

Abstract. The paper analyzes the degree of concentration and competition in Serbian banking sector on the basis of bank financial statements for year 2016. It uses the traditional concentration indicators (CRn and HH indices), as well as the relatively rarely used Linda indices. The concentration degree is calculated based on five variables: total assets, deposits, capital, bank operating income and loans. It was demonstrated that in the case of the relatively large number of banks in Serbia, the existing concentration degree is low, which provides suitable conditions for the development of healthy competition among them.

Keywords. Concentration, competition, banking sector, Serbia, indices Linda, Herfindahl-Hirschman index, concentration ratio
JEL: C38, G21, L10
UDC: 336.71

INTRODUCTION

The last few decades have seen considerable attention being put towards the analysis of development of competition, not only in so called real economy sector but in other branches, as well. Among these other branches, which are infrastructural both on a state level and for the international economy, the banking sector is of particular interest. Its importance has been growing not only in the countries of the former socialist world, which is related with the hugely increased role of market and the consequent deregulation in this and other sectors, but also in developed countries, where deregulation and liberalization processes have also taken place, followed by an integration (mergers and acquisitions) of banks. At the same time, the developed financial markets, especialy the European ones, have become more market-oriented. [Rajan & Zingales, 2003]. In modern economic theory it is assumed that in order to create an efficient market system in all economy segments, especially in the banking sector, it is necessary to provide a competitive environment. Competition in the banking sector is one of the forms of market competition. It appeared lather than competition in industry, but it is characterized by a high intesity and a great diveristy of forms and methods. The main characteristics of the bank competition are described in detail in [Коробова, 2006: 76–100].

After the political changes that took place in 2000, the Serbian banking sector has also undergone some significant changes. The once biggest banks ceased to exist (they were liquidated), some foreign banks entered the market, there were a few acquisitions, etc. At present, there are 30[1] in the market, none of them having a significantly bigger share in the market. For small countries like Serbia, it is a considerable number, and it provides for a development of competition. Foreign banks entering the market and the processes of deregulation and liberalization have naturally created a tougher competition in the banking market. However, there are seemingly no serious and consequent analyses of competition in the market in question. The competition in this sector has not been of particular interest of researchers in the past, although Serbia (Yugoslavia) has had, unlike other socialist countries, considerably developed market relationships, at least in the real sector. Therefore, the most extensive and comprehensive monograph [Begović et al., 2002] does not consider the competition in this sector.

The number of banks and employees in banking sector in the period between 2010 and 2016 is shown on the figure 1. Both the bank and employee figures have decreased substantially in the present decade, by 10% and 20% respectively. However, both figures are still considerable for the relatively

[1] Formally, number of banks in Serbia at December 31st 2016 was 31, because Bank of China Srbija a.d. Beograd received work permit December 20th 2016. Of course, data about its business cannot be included in this analysis.

small financial market of Serbia. Out of the total number of banks, 8 are domestic while 22 are foreign. The domestic – foreign ratio in total assets is 23.3:76.7, and in capital it is 20.6:79.4. The total number of business units (all forms of business network parts: corporate offices, banking subsidiaries, branch offices, counters and other business units) amounts to 1719.

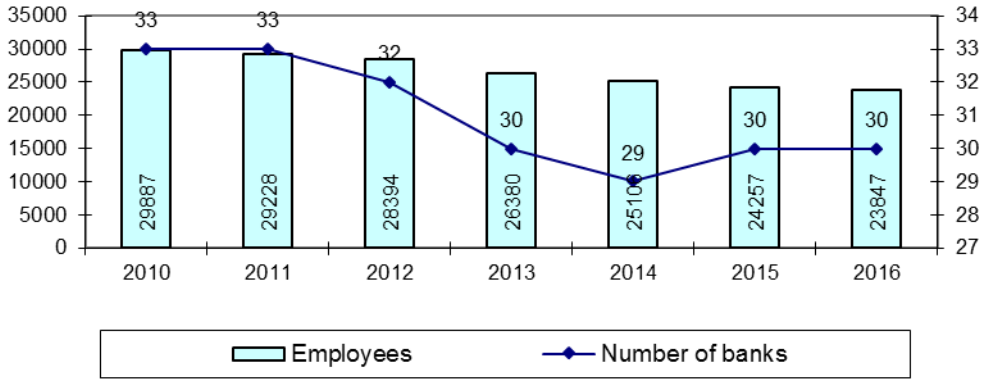

Figure 1. Number of banks and employees in banking sector in Serbia 2010–2016
Source: [17]

METHODOLOGICAL EXPLANATIONS

Competition in general and especially in the banking sector, is a complex process difficult to measure, since = there is no generally accepted or best approach to measuring it, nor is there a unit indicator. Therefore, different approaches have been developed in order to measure the degree of competition in a market. They can be divided into direct and indirect approaches. Direct approaches are based on the degree of market power, as the source of addition to the market price. The direct estimation assumes the existence of data about bank service prices and their marginal costs, which is often lacking. In those cases, we use the indirect estimation method, which can be structural and nonstructural. The first one is based on the paradigm "structure – behavior – result" and suggests using the market concentration degree to measure the degree of competition. The nonstructural estimation denies the correlation between concentration and competition, especially in systems with low entry and exit costs (contestable markets, see [Baumol, 1982]). Within this approach many models examine the relationships between banks performances depending on different exogenous factors (models Panzar-Rosse, Boone and others).

Although we don't identify competition with concentration, our approach can formally be considered as structural. As this research is one of the first steps in competition analysis of the banking sector in Serbia is, we will not apply this approach. After all, concentration coefficients also can be used in the nonstructural approach. We can define concentration as it is defined in the OECD Glossary: "Concentration refers to the extent to which a small number of firms or enterprises account for a large proportion of economic activity such as total sales, assets or employment" [Khemani & Shapiro, 1993], without considering different contexts, which are observed by the Glossary.

Before carrying out an appropriate empirical analysis, an issue is to be resolved. It concerns the variables relative to banks and its business that are to be used. While in the case of manufacture and other branches in real economy sector this issue is less or more solved, the situation is different in the banking sector: variables such as volume of production or sales cannot be used. Therefore, other indicators are necessary. They can be, for instance, attracting deposits [Berger & Hannan, 1989], assets and deposits [Berger et al., 1999], assets, loans and deposits [Ljumović et al., 2014], deposits and loans to legal and physical persons [Коцофана и Стажкова, 2011], deposits, loans to legal and physical persons and assets [Ракша, 2010], deposits, loans to legal and physical persons and capital [Lončar & Rajić, 2012], assets, capital, loans, deposits, interest income and net profit (loss) after tax [Miljković et al., 2013]. A review of literature about the use of concentration measures in banking sector until the beginning of 2000s is given in [Bikker & Haaf, 2002b]. Finally, National Bank of Serbia's regular quarterly reports [Банкарски сектор у Србији. Квартални извештај, 2010–2016]

give short surveys of concentration and competition in the banking sector, using nine financial balance variables: assets, loans (total), loans to population, loans to companies, deposits (total), deposits of population, income (total), interest income, income from fees and commissions. As we can notice, the most frequently used variable is total assets, although its use does not exclude other variables. We will also not limit our research to using only variable, therefore we have chosen five indicators: operating income, total assets, capital, deposits and loans. The choice is due not only to theoretical reasons, but also to the sources accessible to the author: bank financial statements available on the website of National Bank of Serbia [Биланс стања/успеха банака, 2017]. In this paper we will analyze the data for the year 2016, but in certain cases we will refer to works pertaining to the previous years.

The second methodological question is the choice of concentration indicators (index). Among the many indicators, see for instance [Martić, 1986], two have been used by researchers and by the practical antimonopoly policy: coefficients of concentration, or concentration ratios CRn (the share of n largest companies in a certain market, where n mostly stood for 4) and HH index (Herfindahl-Hirschman index, or simply Herfindahl index, the sum of the squares of the shares of all participants' in a market). Both indices are based on individual company shares in a market

$$s_i = \frac{Q_i}{Q} \quad (1)$$

where: Qi = volume of company production i, Q = total production volume in an industry branch. Instead of the volume of production, other variables can be used, as it often occurs even in analyses within the real economy sector, for example income or company assets etc. Coefficients CRn are defined as the sum of n greatest shares, as follows:

$$CRn = s_1 + s_2 + \cdots + s_n = \sum_{i=1}^{n} s_i \quad (2)$$

and coefficients (indices) HH as the sum of share squares of all participants in a market:

$$I_{HH} = \sum_{i=1}^{m} (s_i)^2 \quad (3)$$

We will also use these indices. But, unlike the mentioned work [Ljumović et al., 2014], where were used indices CR4 and CR8, we will use also index CR3. We consider, and this has been demonstrated on multiple occasions, that index CR8 is too high for Serbia, and therefore considered insignificant for the purpose of our work.

The advantages and disadvantages of the indicators (2) and (3) in literature are well described, see for example [Буквич, 2015]. We determined in our calculations both of these indicators, although slightly changed. In addition to that, considering their disadvantages, we choose one more index not yet used in Serbian literature, but also rarely used in other countries, especially in the so-called transition economies. One of the examples of its uses [Коцофана и Стажкова, 2011] refers to the banking sector (in Russia). This index (more precisely, the system of indices) is calculated by following general formula, which is developed into a specific formula for every value of m:

$$IL_m = \frac{1}{m(m-1)} \sum_{i=1}^{m-1} \frac{m-i}{i} \cdot \frac{CRi}{CRm-CRi} \quad (4)$$

This index was constructed by the EU Commission consultant Rémo Linda [Linda, 1976]. As well as the index CRn, it is only calculated in case of the few (m) largest enterprises and, therefore, also analyzes the "nucleus" but not the "periphery" of the market in question. However, unlike the concentration ratio CRn, Linda-index (L-index) focuses on the differences in the market "nucleus". In other words, the L-index has to be considered in combination with the concentration-ratio, it measures the "oligopolistic equilibrium" by giving information about the relative shares and their evolution of the top-firms. We have already showed the advantages of the use of Linda-indices in [Буквич, 2013],

although this article was primarily illustrative. The calculations of this index are alternate and demanding. Of course, the use of personal computers renders the last note insignificant.

In [Ljumović et al., 2014], [Lončar & Rajić, 2012] and [Miljković et al., 2013] Linda-index was not used, but CRn, HH and others were: reciprocity index, comprehensive concentration index or Horvath-index (CCI), Entropy-index (E-index) and Gini-coefficient. For our purposes, all other indices except the CRn index bear no importance.

CONCENTRATION AND COMPETITION IN SERBIAN BANKING SECTOR

Unlike some empirical researches, which divide the banking sector into small, middle and large banks, see for example [Bikker & Haaf, 2002a], we will consider the whole sector as one set. Clearly, it doesn't mean that in a theoretical sense we prefer such approach. The main reason for our choice is obvious enough: regardless of the relatively large number of banks, the banking and financial markets in Serbia are small, by all relevant indicators: total bank assets in December 2016 amounted to 3.241.505 million dinars, while the capital equaled to 632.486 million dinars (by exchange rate of 1 euro = 123,4723 dinars). Therefore, for this work purposes we don't find this division useful by any criteria.

Table 1. Concentration indices in Serbian banking sector in 2016

Criterion	CR3	CR4	CR8	HH
Total assets	39.6	47.4	69.4	813
Deposits and other liabilities	40.1	47.9	69.7	819
Capital	38.7	47.4	73.6	882
Operating income	36.8	44.6	67.9	764
Loans and receivables	36.9	45.3	67.9	763

Source: Based on Financial Statements, http://www.nbs.rs/internet/cirilica/50/50_5.html

Table 2. Hirschman-Herfindahl indices for chosen indicators in Serbian banking sector 2010–2016

Balance variable	2010	2011	2012	2013	2014	2015	2016
Assets	629	660	678	741	794	796	813
Loans (total)	649	722	721	774	771	763	736
to population	687	684	687	714	715	729	728
to companies				788	779	782	768
Deposits (total)	720	714	726	777	818	816	817
from population	796	799	811	866	903	930	939
Income (total)	679	721	916	844	719	734	804
interest income	620	640	678	712	736	734	737
from fees and commissions	739	722	760	828	849	860	879

Source: [17]

In case of both coefficients (CRn and HH), the limits between different market concentration degrees are set arbitrarily. So, USA has been using HH-indices for market classifications since 1982. Before that, the limits had been set on 1,000 and 1,800, and since 2010, they have been 1,500 and 2,500 [Horizontal Merger Guidelines, 1997; Horizontal Merger Guidelines, 2010]. The antimonopoly authority in Russia uses the limits 45% and 70% for CR3, and 1,000 and 2,000 for HH to separate lowly, moderately, and highly concentrated markets [Федеральная антимонопольная служба, 2016]. The values of HH indices for all variants in our analysis are less than 1,000, so the market should be classified as lowly concentrated. On the other hand, according to the CR3 index, it also belongs to non-concentrated markets, but if were to use the Cr4 index, we would have to classify the market as a moderately concentrated one (except for the third variant, the capital, but in that case, the value of CR4 is practically on the limit between a non-concentrated and a moderately-concentrated market).

The indices of CRn and HH are also used by the National Bank of Serbia in the mentioned reviews of concentration and competition presented in the Bank's quarterly reports. However, due to reasons unknown to the author of this work, they do not use the indices CR3 and CR4, which are justified from the standpoint of small markets and a small number of participant in the market, but they use indices CR5 and CR10 instead, considering share of five, i.e. ten largest banks. We deem that the use of these indices inadequate adequate and will not consider them. Instead, we can consider the results obtained from the report through the use of HH index (see table 2).

All index values in table 2 are less than 1,000, therefore the market should by all indicators be classified as low concentrated. This is constantly emphasized in the reports. However, there is an obvious growth trend in practically all values, with a significant increase in some cases. In this sense, even if we ignore the problem of arbitrary limits between the different market concentration types, there is hardly any room for the satisfactory report estimations that are constantly being repeated («The banking market in Serbia is still characterized by a satisfactory level of competition and a low concentration of activity»). The paper [Miljković et al., 2013], that analyzes the period between 2008 and 2012, demonstrated a growth trend of HH index practically for all observed financial balances variables, with very small exceptions only in certain years and for some variables, so it can be concluded that there is an almost ten years' growth trend of HH indices in the Serbian banking sector.

Clearly, other possible limits between lowly, moderately and highly concentrated markets could result in a different classification. This is one of the main flaws of the CRn and HH index use. Therefore, other approaches to researching concentration and competition are also necessary. One of them are Linda-indices. Unlike the previously mentioned ones, Linda-indices are meant to reveal the existence of oligopoly structures without using any arbitrarily established limits. In contrast, the index values indicate whether oligopoly is present or not in a given market. In the case of a competitive market, the index value decreases ($IL_{m+1} > IL_m$ for all m). If this pattern is broken, it indicates that there is an oligopoly situation in a given market. In our case, only the third variant points out to the existence of oligopoly, which are the Linda-indices calculated on the basis of the capital value (see Table 3). Besides the Linda-indices (V1, V2, V3, V4, and V5, for five values in Table 1), it also shows the column (PE). It represents the so-called perfect equilibrium curve, which is the situation of perfect equality among the participants in a marketplace. The shares of such perfect competitors are the same one to another, and equal to the value 1/n (n = number of participants in market).

Table 3. Linda indices for selected indicators in the banking sector, Serbia in 2016

IL	V1	V2	V3	V4	V5	PE
						1
IL2	0.6892	0.6317	0.9668	0.7618	0.6980	0.5
IL3	0.4897	0.4750	0.6234	0.5078	0.4815	0.333
IL4	0.4154	0.4132	0.4398	0.4058	0.3787	0.25
IL5	0.3459	0.3493	0.3405	0.3237	0.3212	0.2
IL6	0.3174	0.3323	0.2822	0.2943	0.3019	0.167
IL7	0.2993	0.3025	0.2540	0.2717	0.2758	0.143
IL8	0.2749	0.2708	0.2665	0.2523	0.2514	0.125
IL9	0.2535	0.25098	0.2662	0.2309	0.2392	0.111
IL10	0.2121	0.20947	0.2272	0.1954	0.2004	0.1

Source: Обрачун на основу Financial Statements, http://www.nbs.rs/internet/cirilica/50/50_5.html

The third variant (variable V3, i.e. capital) indicates oligopoly (IL8>IL7): the sequence of indices ILi is not monotonically decreasing function. However, the observed variable (capital), as residual of assets and liabilities, is the "worst quality" variable among the chosen ones. Therefore, having taken into consideration the other results from Table 3, it could be said with great certainty that the results obtained by coefficients CR3, CR4 and HH were confirmed, i.e. that the Serbian banking sector in 2016 is lowly concentrated. And this is the good foundation for competition development.

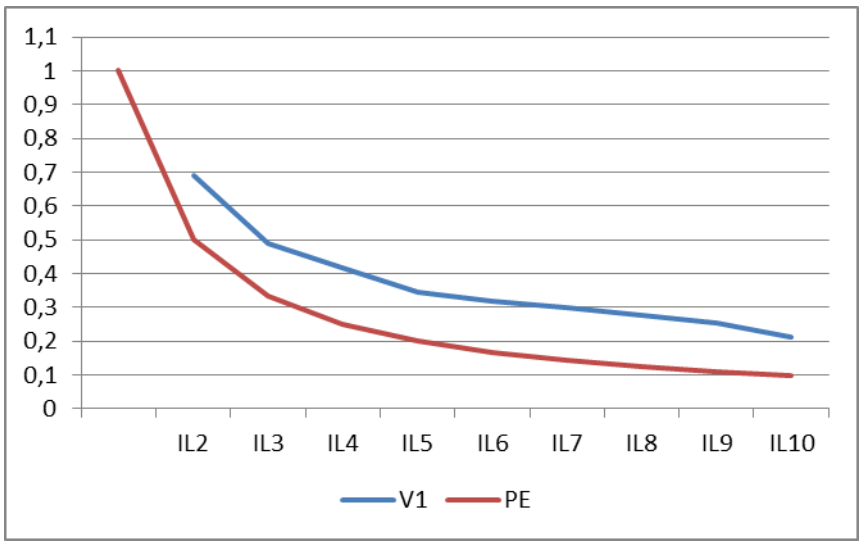

Figure 2. Linda indices for assets and "perfect equilibrium" curve for banking sector, Serbia 2016

Source: On the base of Financial Statements, http://www.nbs.rs/internet/cirilica/50/50_5.html

The graphical representation of Linda-index is also of great interest (see Figures 2 and 3). It shows indices for assets (Figure 2), as the most widely-used balance variable for the purposes of such analyses of concentration and competition in the banking sector. It also shows indices for capital (Figure 3), where, as shown in Table 3, there is a suspicion of oligopolistic structures. Unlike the indices CRn, which are a monotonically increasing function as each next participant is added (CR1<CR2<…<CRn), Linda indices form a broken curve (Figures 2 and 3). The area between IL and PE is named "oligopolistic arena" and it even visually shows the difference between the real situation and an ideal, perfect competition.

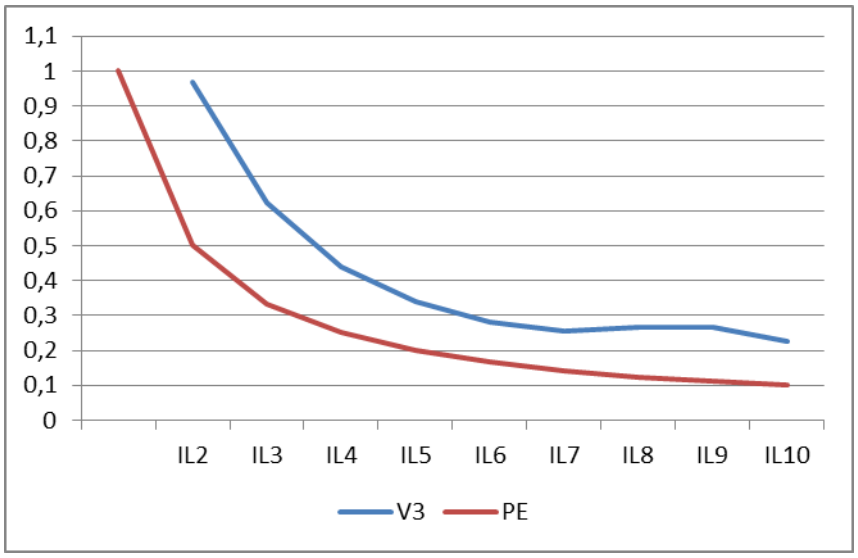

Figure 3. Linda indices for capital and "perfect equilibrium" curve for banking sector, Serbia 2016

Source: On the base of Financial Statements, http://www.nbs.rs/internet/cirilica/50/50_5.html

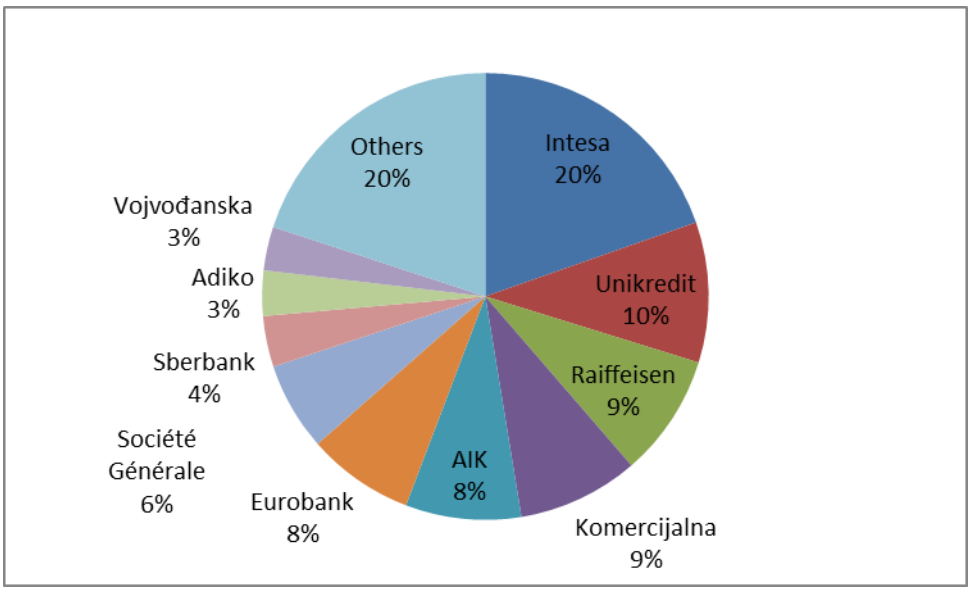

Figure 4. The shares of leading banks in total banking sector capital
Source: On the base of Financial Statements, http://www.nbs.rs/internet/cirilica/50/50_5.html

The bank shares in the total banking sector capital are shown on Figure 4. They suggest, that the first seven banks form an oligopolistic structure – the seventh one in range (Société Générale) is greater by over 70% in terms of capital than the next, eighth one (Sberbank) (the shares are 6.4 : 3.7). If so, of course, this could be a case of so-called loose oligopoly, in which, by theoretical propositions, 6–7 firms participate in a market with a 70–80% share. In our case, this share for the first seven firms is 69.9%. Therefore, such a conclusion can be drawn. The state of the banking market must be permanently observed, because the values of coefficients HH, even CR4 are close to being moderately concentrated. As shown previously, the National Bank of Serbia does so, although through the use of simple instruments.

CONCLUSION

Banking market in Serbia is characterized by a relatively large number of banks (30). Among them there are no prominently large banks. According to all the chosen indicators (operating income, total assets, deposits and capital), the greatest share is held by the Intesa Bank (16.4; 19.6; 16.6; 17.0 and 15.8%, respectively). The concentration indices (CR3, CR4, HH and Linda indices IL) indicate a low concentration degree, although close to being moderately concentrated, but also an absence of oligopoly, with the mentioned exception. Even though this does not assume the existence of true competition, these results point out to good perspectives for creation and development of competition. In fact, we could consider that our results confirm the results obtained by [Lončar & Rajić, 2012] and [Miljković et al., 2013], which referred to three quarters of 2012, as well as those of [Ljumović et al., 2014], for the period between 2003 and 2012. However, we should take account of slight growth in concentration. It is difficult to compare the results of these works due to the differing approaches that were used, although the application of the HH index is a solid foundation for comparison in such cases.

As banking competition is very complex, this paper should be considered as one of the first analyses of concentration and competition in banking, and in the Serbian financial market in general. We hope that it will be a research subject of other researchers. New approaches would, naturally, be desirable in such future researches.

In addition to the fact that the concentration degree is not high despite its increase, more attention should be put towards the actions of banks in the market, which falls under the scope of regulation and control. In particular, the issues of collusion and deals between banks should be dealt with, although they have not been considered in this paper.

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REFERENCES

1. Baumol, W.J. (1982) Contestable Markets An Uprising in the Theory of Industry Structure, *The American Economic Review*, 72 (1), 1–15.
2. Begović, B.; R. Bukvić, B. Mijatović, M. Paunović, R. Sepi & D. Hiber. (2002) *Competition Policy in FR Yugoslavia – Existing Market Structures and Competition Institutions*, Belgrade: Center for Liberal-democratic Studies.
3. Berger, A.N.; R.S.Demsetz, P.E. Strahan. (1999) The consolidation of the financial services industry: Causes, consequences, and implications for the future, *Journal of Banking & Finance*, 23 (02–04), 135–194.
4. Berger, A.N. & T.H. Hannan. (1989) The Price-Concentration Relationship in Banking, *The Review of Economics and Statistics*, 71 (2), 291–299.
5. Bikker, J.A. & K. Haaf. (2002a) Competition, concentration and their relationship: An empirical analysis of the banking industry, *Journal of Banking & Finance*, 26 (11), 2191–2214.
6. Bikker, J.A. & K. Haaf. (2002b) Measures of Competition and Concentration in the Banking Industry: a Review of the Literature, *Economic & Financial Modelling*, 9 (2), 53–98.
7. Bukvić, R. (1999) Istraživanja tržišnih struktura u privredi druge Jugoslavije, *Ekonomika*, 35 (1), 4–16. /Researches of the Market Structures in the Economy of the Former Yugoslavia, *Ekonomika*, 35 (1), 4–16. In Serbian./
8. Horizontal Merger Guidelines, U.S. Department of Justice and the Federal Trade Commission, Issued: April 2, 1992, Revised: April 8, 1997. www.justice.gov/atr/public/guidelines/hmg.pdf
9. Horizontal Merger Guidelines, U.S. Department of Justice and the Federal Trade Commission, Issued: August 19, 2010. www.justice.gov/atr/public/guidelines/hmg-2010.pdf
10. Khemani R.S. & D.M. Shapiro (compiled by) (1993). *Glossary of Industrial Organisation Economics and Competition Law*, commissioned by the Directorate for Financial, Fiscal and Enterprise Affairs, OECD.
11. Linda, R. (1976) Methodology of concentration analysis applied to the study of industries and markets, Brussels: Commission of the European Communities.
12. Ljumović, I.; V. Pavlović, J.M. Cvijanović. (2014) Two Aspects of Concentration in Serbian Banking Sector, *Industrija*, 42 (3), 61–77.
13. Lončar, D. & V. Rajić. (2012) Concentration and Competitiveness of Banking Market in Serbia: Current Situation and Possible Future Changes under the Influence of Market Consolidation, *Ekonomika preduzeća*, 60 (7–8), 372–385.
14. Martić, Lj. *Mjere nejednakosti i siromaštva*, Zagreb: Brotehnika, 1986. /Unequality and Poverty Measures, Zagreb: Birotehnika, 1986. In Croatian./
15. Miljković, M.; S. Filipović, S. Tanasković. (2013) Market Concentration In The Banking Sector – Evidence From Serbia, *Industrija*, 41 (2), 7–25.
16. Rajan, R.G. & L. Zingales. (2003). Banks and Markets: The Changing Character of European Finance, NBER Working Paper 9595, Cambridge.
17. Banking Sector in Serbia. Quarterly Report, 2010–2016 (Serbian: *Банкарски сектор у Србији. Квартални извештај, 2010–2016)*, Belgrade: National Bank of Serbia).

18. Banking Financial Statements (Биланс стања/успеха банака), Београд: Народна банка Србије, 2017. (Belgrade, National Bank of Serbia 2017), http://www.nbs.rs/internet/cirilica/50/50_5.html
19. Bukvich, R. (Буквич, Р.), 2013, Research of Market Structure: Linda concentration index, *Problems of the Theory and Practice of Management*, (10), 49–55 (Russian: Исследование рыночных структур: индекс концентрации Линда, *Проблемы теории и практики управления*, (10), 49–55).
20. Bukvich, R. (Буквич, Р.), 2017, Концентрация в банковском секторе Сербии в 2016 году (Concentration in the Banking Sector of Serbia in 2016), Международная научно-практическая конференция «Современные достижения науки и пути инновационного восхождения экономики региона, страны», 18 мая 2017, Комратский государственный университет и Научно-исследовательский центр «Прогресс» (International Science and Practice Conference "Modern Achievements of Science and Ways of Innovative Ascendance of Regional and National Economies), 18 May 2017, Comrat, Republic of Moldova, 2017, pp. 325–330.
21. Bukvich, R. (Буквич, Р.), 2015, *Market: Competition and Monopoly*, Knyaginino: Nizhny Novgorod State University of Engineering and Economics *(Russian: Рынок: конкуренция и монополия*, Княгинино: Нижегородский государственный инженерно-экономический университет), 2015.
22. Korobova, G.G. (ed.) / Коробова, Г.Г. (ред.), 2006, *Banking*, Moscow: Ekonomist (Russian: *Банковское дело*, Москва: Экономист, 2006).
23. Kotsofana, T.V. & P.S. Stazhkova. (Russian: Коцофана, Т.В. и П.С. Стажкова), 2011, Comparative analysis of the use of concentration indicators on the example of banking sector of RF, Vestnik of Sankt-Petersburg State University. Series Economics, (4), pp. 30–40, (Russian: Сравнительный анализ применения показателей концентрации на примере банковского сектора РФ, *Вестник Санкт-Петербургского Государственного Университета. Серия Экономика*, (4), 30–40).
24. Raksha, A.D. (Ракша, А.Д.), 2010, Competition in Banking Sphere, *Banking*, (11), 25–27 (Russian: Конкуренция в банковской сфере, *Банковское дело*, (11), 25–27)
25. Federal Service Antimonopoly (Russian: Федеральная антимонопольная служба), 2016, On approval of the analysis of the state of competition in the commodity market (as amended on July 20, 2016), Russian: Об утверждении Порядка проведения анализа состояния конкуренции на товарном рынке (с изменениями на 20 июля 2016 года) от 28 апреля 2010 года N 220, http://docs.cntd.ru/document/902215421 /

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CAPITAL TURNOVER AS DETERMINANT FACTOR OF THE FINANCIAL PERFORMANCE OF INDUSTRIAL ENTERPRISES - AN EMPIRICAL ANALYSIS

NEDELCU ANA,
PhD in economics, associate professor,
Cahul State University „B.P.Hasdeu"
ana_nedelcu@rambler.ru

Abstract. *The actuality of the given research is determined by the importance of financial performance for any enterprise. This concept is multidimensional and transdisciplinary and its complexity has conditioned the use of different evaluation approaches and methods. Thus, the evaluation of financial performance is still an actual research topic.*

Financial performance is influenced by a wide range of factors. One of such factor is considered to be capital turnover. The current state of studying the relationship between capital turnover and financial performance has focused on developing the methodological framework for assessing the influence of the capital turnover not on the financial performance as an integrating concept but on its various dimensions (profitability, liquidity, solvency, etc.).

This research paper aims to clarify such concepts as capital, performance, financial performance. Moreover, it seeks to develop a reliable methodology of financial performance evaluation as a whole concept based on an aggregated index, which will lead to a better understanding of the relationship between capital turnover and financial performance of industrial enterprises.

Keywords: *capital, capital turnover, performance, financial performance, performance evaluation, industrial enterprises.*

JEL: G31, M41
UDC: 336.76

Introduction

The enterprise is an essential component of economic development, and its fundamental objective is financial performance. The current context of the national and global economy reveals an upward trend in identifying performing businesses. Thus, performance and performance measurement are now the point of maximum interest for managers, shareholders, and, of course, potential investors.

Indicators are instruments for performance evaluation. Using a single indicator to estimate an enterprise's performance becomes irrational due to the complexity of economic phenomena and processes. Starting from the extensive literature focusing on the financial performance assessment, the author notes that, in an evolutionary context, traditional indicators such as financial result and profitability are insufficient to assess, control and improve the financial performance of an enterprise that operates in a dynamic and hyper-competitive environment. At the same time, the author claims that in order to obtain a pertinent and harmonious representation of the financial performance of the enterprise it is necessary to use an aggregate indicator, which will encompass its multidimensional character.

The importance of this scientific approach is justified by the fact that financial performance is the source of the progress of any enterprise, and the understanding of the multiple valences of this concept and factors contributing to the enhancement of performance is utmost important. The enterprise's capital, as the most important factor of production, fulfills its defining role in the process of creating value added, which allows the author to assert that capital is a determinant of financial performance.

What is more, the industrial enterprises face major problems in using their capital. At present, the slowdown in the turnover of the beverage industry by 28%, accompanied by a higher degree of indebtedness, causes a state of non-financial performance of wineries. The beverage industry, with a 1034-day capital turnover, recorded the lowest level of financial performance, while car industry enterprises and light industry enterprises reached higher levels of financial performance due to a shorter turnover period (372 days and 322-day capital).

The exposed issues confirm the actuality of the research theme and condition the investigation and resolution of the problems related to the efficient use of the capital of the industrial enterprises in the context of the financial performance's increase.

Analysis of recent researches and publications

The relationship between capital turnover and financial performance is a vital issue which has not been resolved in the finance field. In order to research these financial concepts and their relation, author proceeded to the investigation of the following concepts: capital, performance, financial performance and capital turnover.

Research on the evolutionary realities of the concept „capital" shows that capital is now the most important factor of production which fulfills the defining role in the process of value creation.

The development of concept „capital" as a factor of production was initiated with its primary definition as "a sum of money given in a loan" in the work of mercantilists [6]. Physiocrats have made a major contribution to explaining the concept of capital by delimiting fixed capital from the circulating one [10]. Adam Smith, in his famous work "The Wealth of Nation", has embodied the differences between capital and wealth, which has allowed understanding of the complex nature of the enterprise's capital and perceiving its essence as a determinant of financial performance [23].

Although, the author disagrees with the J.S. Mill's statement, according to which circulating capital adds value only by the change of the owner and the fixed one by holding it [12]. Instead, author considers that the capital adds value through the process of its rotation, which in its essence, consists in the successive change of functional forms and the return to its primary form (money capital) of a higher value.

In the Marxist vision, labour has been seen as a component part of capital that creates a surplus value. This idea forms the basis of Marxist critique of capitalism, according to which bank and commercial capital do not produce added value [9].

Generalizing the neoclassical approach, the author emphasizes its contribution to capital theory by considering capital as the main factor of production. However, the author disagrees with the position of Jevons W.S., according to which capital as a production factor holds a lower position than the labor factor [11], and with the opinion of Clark J.B., according to which only the material form of capital is the only representation of "true capital" [7].

Currently, capital is considered to be the most important factor of production. The diversity of its categories identified in research literature determines the major complexity of this concept. Thus, economic theory distinguishes the following components of capital: natural capital, economic capital, financial capital, human capital and social capital.

The research of recent theories [1,2,8,13] on the role of capital for financial performance, from a critical perspective, allows the author to conclude that economic and financial capital have a central role in obtaining, maintaining and improving the level of financial performance of an enterprise. Financial capital and the economic one, through the process of turnover, determine the creation of added value and therefore contribute to the achievement of financial performance. At the same time, the author considers that the human capital and the social one indirectly influence the level of financial performance. Knowledge, skills of managers and other employees can contribute to the efficiency of the production process, which enhance the speed of capital turnover. At the same time, mutual trust between the enterprise and its suppliers or customers contributes to streamlining the supply and marketing activities, therefore positively influencing the process of capital turnover, increasing the level of sales and the level of financial performance [14]. In this context, the author asserts that capital, due to its defining role in the process of value creation, is a determinant of financial performance, and efficient use of capital is a primary condition for enhancing the financial performance of an enterprise.

Performance is a modern and universal concept, the meaning of which varies from one domain to another. In economic sciences there is no unanimity in treating this term, nor in its evaluation. The diversity of the approaches is the repercussion of the polysemantic use of the concept. The research of the concept of financial performance in an evolutionary and transdisciplinary perspective allowed the author to realize the following:

- In the economic field, performance is perceived as a result of an enterprise's activity, which is achieved in terms of efficient use of resources, reflecting the newly created value and the achievement of the proposed objectives. From the reported ones, the performance of the enterprise, in a narrow sense, is a result of the enterprise's activity, while, in a broad sense, performance is "a strategic and integrated process that ensures the long-term success of the enterprise" [16].
- In the context of a ***transdisciplinary approach***, financial performance is treated differently. Accounting and finance fields identify financial performance with the performance of the entire enterprise, while managerial and social sciences challenge this affirmation, arguing that financial performance is a component of enterprise performance. Enterprise performance can not be defined solely through the achievement of financial objectives, while neglecting other aspects of enterprise performance: *operational, social and environmental dimensions.* The approach from financial and accounting perspectives considers that the *financial performance is the success of the enterprise, which means obtaining financial results and value creation for shareholders.* From a managerial point of view, *the enterprise performance includes the financial component, ie the financial performance, reflecting the achievement of the financial objectives, and the non-financial component, called operational performance, describing the achievement of the enterprise's objectives in areas such as market, consumers, competition*, etc. In the context of sustainable development, financial performance gains another connotation. Achieving financial goals or creating new value for shareholders is just a facet of enterprise performance that is essential alongside the value created by the enterprise for the whole of society and the environment [15].
- The complexity of the concept of financial performance is conditioned not only by the fact that it is addressed by various disciplines but also by its multidimensional character. The study of a wide range of domestic and foreign scientific publications on this concept allowed the author to identify the most commonly used dimensions of financial performance: *profitability (return), financial result, growth, capital turnover, financial stability, value added, market value, ability to pay , cash flow and financial equilibrium.* According to the author, an enterprise is performant if its activity is expanding *(growth),* positive financial results are recorded *(financial result),* the invested capital generates profit *(profitability),* the enterprise is able to pay its bills *(the ability to pay),* the enterprise's activity generates cash flows in increasing volume *(cash flow),* the enterprise uses its capital in an efficient manner *(the capital turnover)* within an optimal financial structure *(financial stability)* and under minimum risk *(financial equilibrium),* the activity of the enterprise creates a surplus of economic value *(value added)* and contributes to the increase of the market value [18].

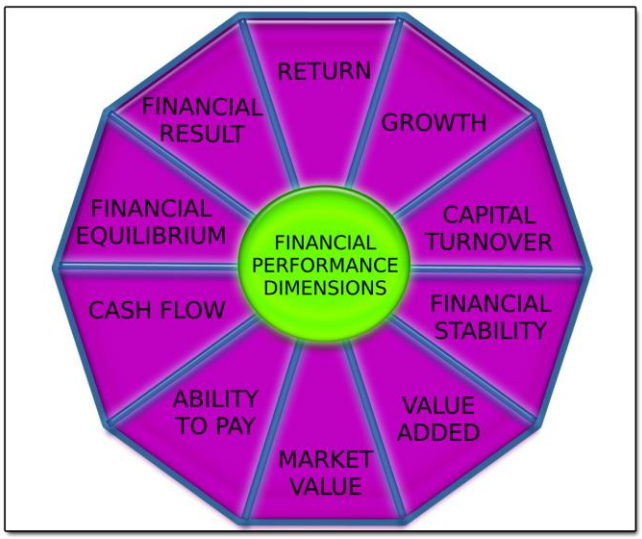

Figure 1. Financial performance dimensions
Source: Developed by the author

In this context, the author concludes that, besides the same complexity, the concept „financial

performance" is narrower than the concept of enterprise performance. At the same time, its multidimensional character creates a series of controversies regarding the assessment of financial performance, which highlights the need for more in-depth research on this issue. Finally, taking into account the transdisciplinary and multidimensional approach, the author defines financial performance as ***a new value created for shareholders, expressed by the ascending dynamics of the financial state of the enterprise.***

The enterprise maintains its capital through its permanent reproduction, ie through the process of turnover. The author considers that the capital turnover means the passage of the three phases (purchase, production, sale) and the return of the capital to the initial form of a higher value, which leads to the creation of an additional value, thus increasing the financial performance. By synthesizing the views on the relation between the capital and the financial performance, the author concludes that the fact that the number of rotations in a period of time is greater or the period of a rotation is smaller determines the creation of a greater amount of value, leading to the enhancement of financial performance, in other words, speeding up capital turnover increases financial performance [17].

Evaluating financial performance is an extremely important activity for any enterprise. The assessment of financial performance allows identification of the factors that influence its increase or decrease, which gives the possibility to control the level of performance and eventually to improve it [20].

Researching the current state of development of the financial performance assessment methodology has enabled the author to identify six scientific approaches: *accounting approach, financial approach, global approach, goal-based approach, behavioural approach and stakeholder approach*. Generalizing all these approaches, the author concludes that the accounting, financial and global approaches provide the methodology of assessment of the financial aspect of performance, ie financial performance, which can be estimated with a high degree of accuracy and objectivity, and the data obtained can be generalized and used for time and space comparisons. The global and stakeholder approach implies assessing the performance of the enterprise vis-à-vis several stakeholders (shareholders, managers, consumers, employees), however the global approach provides a higher degree of objectivity (this is done by using less subjective primary data: net profit per share, number of complaints, compliance with environmental rules, etc.). While the stakeholder approach involves assessing not just the created value for interest groups but also how these groups have contributed to value creation, which makes evaluation more subjective [20].

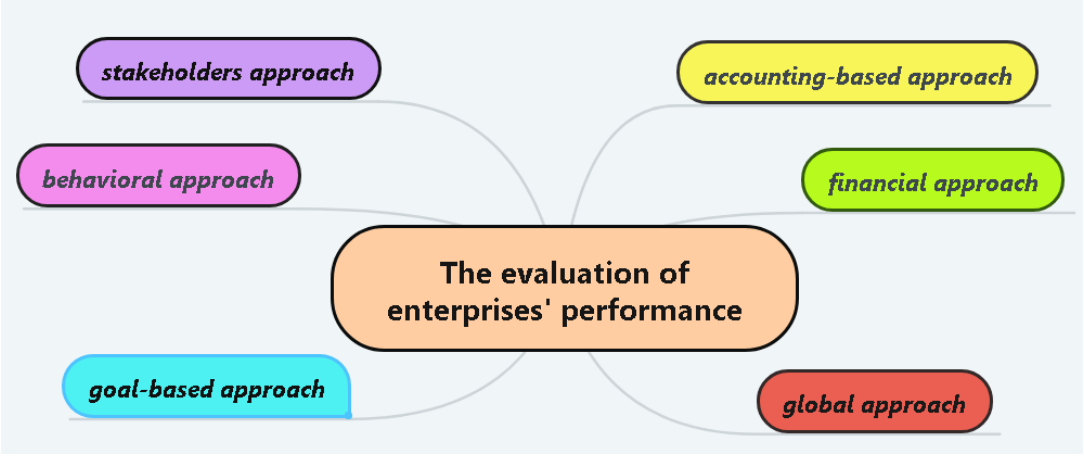

Figure 2. The approaches to the performance evaluation of enterprises
Source: Developed by the author

The diversity of approaches to assessing financial performance has conditioned the use of different evaluation methods, the application of which depends on the purpose of the research. In this context, the author distinguishes four basic categories of evaluation methods:

- the method of financial ratios involves analyzing the evolution of different performance dimensions;

- the scores method allows the calculation of the overall level of financial performance based on financial ratios that estimate performance dimensions;

- the regression analysis method gives the possibility of calculating the overall level of financial performance and estimating the influence of factors at a significant statistical level;

- the multi-criterion analysis method allows for a ranking of enterprises according to the level of financial performance [21].

Choosing a concrete method of assessing financial performance depends on the purpose of the proposed research. At the same time, according to the author, the method of ratios remains the basis of the other evaluation methods, therefore, the author considers that regardless of the approach and the method of evaluation selected by the researcher, the first step in the process of evaluating the financial performance is identification of its dimensions and structuring a system of evaluation indicators able to capture the most important dimensions of performance: profitability, liquidity and ability to pay, financial balance, the ability of the entity to adapt to the requirements of the market in which it operates, etc.

The current state of affairs in research of the relationship between capital turnover and financial performance (the DuPont model, the factorial model of the financial result, the model of the cash conversion cycle) shows that the acceleration of capital turnover leads to an increase in profitability ensures liquidity and solvency of the enterprise and increases the net cash flow. As a consequence, the author concludes that researchers have focused on developing the methodological framework for assessing the influence of the capital turnover not on the financial performance as an integrating concept, but on its various dimensions (profitability, liquidity, solvency, etc.). In this context, the need to develop a methodology for assessing the effects of the capital turnover on financial performance, in line with its multidimensional character, is absolutely justified.

Research Methodology

In order to achieve all the objectives referring to the scientific research, this particular research is based on the systemic approach, which is applied to concepts studying as well as to assessment of current situation of analyzed domains. During the research, the following traditional methods were used: logical, dialectical method (scientific abstraction, analogy, analysis and synthesis, induction and deduction). Also, some specific research methods were applied such as: graphical method, economic comparison, analytical table method, absolute and relative size method, rate method, scoring method, Dupont method, logistic regression method and panel data regression method. The information support of the research was provided by the official data of the National Bureau of Statistics, the National Commission of the Financial Market, the National Bank of Moldova, as well as by the author's own estimates and analyzes.

The aim of the article

The purpose of this research is to develop an aggregated index of financial performance that will allow to highlight how the capital turnover influences the level of financial performance of industrial enterprises.

In the effort to achieve the proposed goal, the following objectives were formulated:

• Studying the evolutionary aspects of an enterprise's capital concept as a determinant of financial performance;

• Researching the context in which financial performance has evolved and developed, dimensioning the current state of knowledge through an evolutionary and transdisciplinary approach;

• Systemise conceptual approaches to financial performance assessment methods;

• Reflecting the interdependence between capital turnover and financial performance;

• Analysis of the current state of financial performance of industrial enterprises and empirical research of the effects of the capital turnover on it;

• Elaboration of the methodology for estimating the effects of the capital turnover on the financial performance of industrial enterprises;

• Identify directions for speeding up capital turnover to enhance financial performance.

Research results

This research analyses the industrial sector, which is utmost important for economic development of Republic of Moldova. This statement is argued by its contribution to the production volume (24%) and to the GDP (12%). The results of the research show that the main industrial sectors, according to the share in the value of production, the number of enterprises and the volume of exports are: the beverage industry, the light industry and the machinery, equipment and appliances industry (Table 1). These industrial fields account for more than 20% of the enterprises of the manufacturing industry, which produce about 28% of total industrial production and export almost 40% of goods.

The purpose of analyzing the financial performance of industrial enterprises lies in the clear distinction between performing and non-performing enterprises as well as in identifying factors that have led to performance or non-performance. The financial ratio method is applied as a method of assessing financial performance. The financial ratios are calculated on the basis of the performance dimensions identified in the theoretical part of the paper: financial result, profitability, growth, financial stability, payment capacity and financial equilibrium.

Table 1. The shares of the beverage industry, the light industry and the machinery, equipment and appliances industry in manufacturing industry and exports, %

Indicators	2011	2012	2013	2014	2015
1. The beverage industry					
1.1. Share in production value of the manufacturing industry	10,89	12,08	13,01	10,87	10,77
1.2. Share in the number of enterprises	3,55	3,46	3,66	3,60	5,04
1.3. Share in the volume of exports	8,18	9,94	10,39	8,28	8,14
2. The light industry					
2.1. Share in production value of the manufacturing industry	8,97	8,84	9,91	10,75	11,39
2.2. Share in the number of enterprises	8,12	8,43	9,24	9,12	12,05
2.3. Share in the volume of exports	19,82	19,17	16,47	17,05	16,41
3. The machinery, equipment and appliances industry					
3.1. Share in production value of the manufacturing industry	3,49	4,01	3,47	5,07	5,97
3.2. Share in the number of enterprises	6,52	6,70	7,17	7,41	3,88
3.3. Share in the volume of exports	12,78	12,89	13,01	13,23	15,02

Source: Developed by the author based on data of the National Bureau of Statistics

The financial result is a well-defined performance dimension, which accurately estimates the company's ability to earn profits from its activity. Assessing this financial performance's dimension involves analyzing sales revenue, gross profit, net result, and so on. The analysis of financial performance in terms of financial result indicators provided the following results [3]:

- The sales revenue of the investigated industrial enterprises shows an upward trend, with the exception of the beverage industry, whose sales revenue has declined by 24% in 2014, which has significantly compromised the financial performance of these enterprises.

In the given context, the author identifies the following directions for increasing the level of sales revenue:

- *- Diversifying the sales markets;*
- *- Developing the national quality wine brand* through *high quality, impressive*

traditions and unique personality. The Protected Geographical Indications are helpful, as the certified origin offers a guarantee of quality for the consumer and such wines are sold much better than others (by 15-20%);

- - *Developing efficient and robust marketing strategies* that will enable sectoral positioning in foreign markets;
- - *Continuing legislative reforms and ensuring a credible quality framework* (Figure 3).

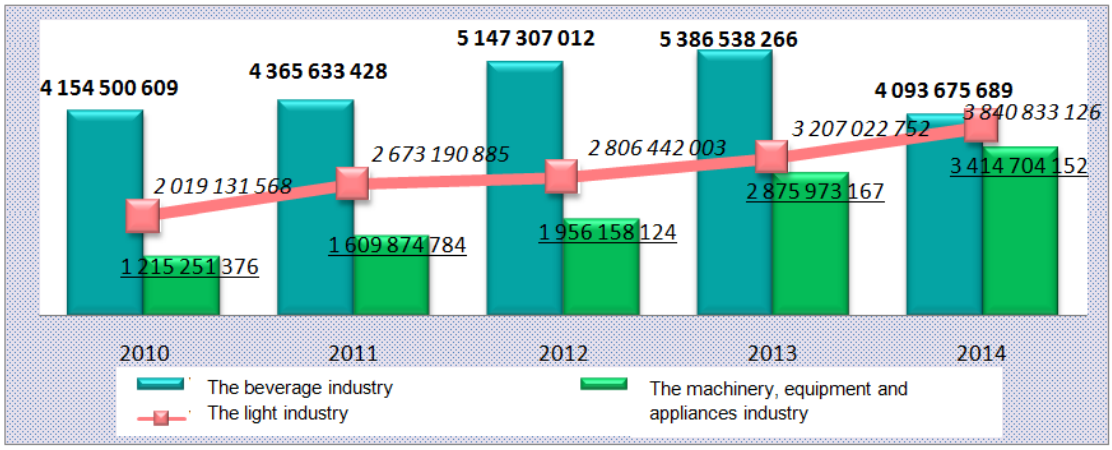

Figure 3. The comparative evolution of sales revenue in period of 2010-2014, lei
Source: Developed by the author based on data of the National Bureau of Statistics

- In the context of gross profit analysis, the author finds that the financial performance of the machinery industry is affected by inefficient production cost management, which causes sales costs to grow more rapidly than sales revenue, resulting in a reduction in gross profits. In this respect, the author proposes the following measures: *increasing labour productivity; optimizing technology costs, streamlining management control, and using objective allocation keys*.
- Comparative analysis of the net financial result of industrial enterprises shows that: the beverage industry does not manage to achieve a positive net financial result; whereas the light industry enterprises have the highest net financial result; while machinery industry enterprises have net profit, but its level has been oscillating during the analysed period (Figure 4).

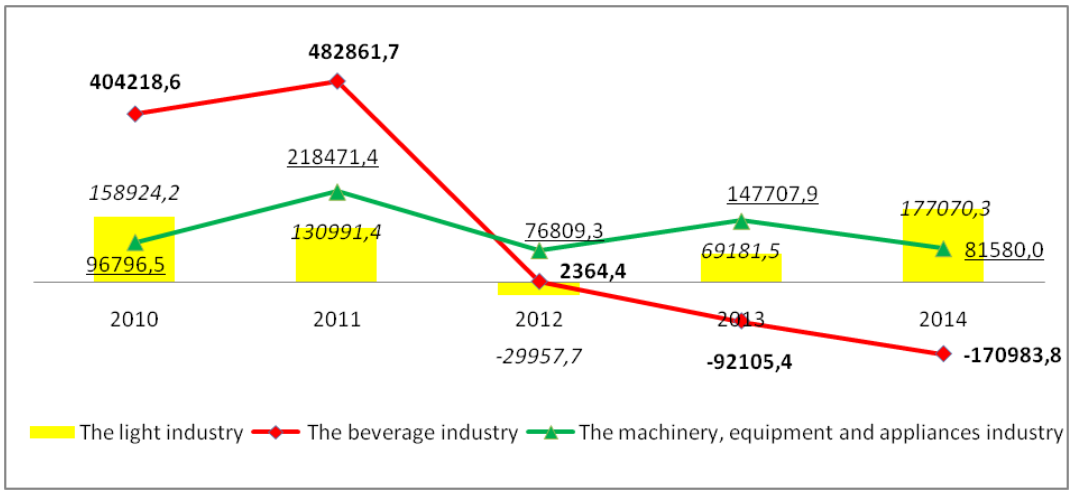

Figure 4. The comparative evolution of net result in period of 2010-2014, lei

Source: Developed by the author based on data of the National Bureau of Statistics

Profitability (return) is one of the most synthetic forms of expressing the financial performance of an enterprise, which reveals the efficiency of capital use in various stages of the

economic circuit, while ***growth*** indicators allow quantification of the business expansion. In the author's view, growth indicators need to be analyzed along with cost-effectiveness indicators, as growth only reveals the quantitative aspect of performance.

The analysis of the profitability indicators reveals that although the enterprises of the beverage industry have reached the highest level of the commercial rate of return - 30.15%, these enterprises have failed to obtain positive values of the economic and financial profitability indicators, while the highest level of these indicators is recorded by light industry enterprises [3]. In this context, the author concludes that enhancing the profitability of the beverage industry enterprises is an important direction towards increasing the financial performance, *that can be achieved by increasing sales revenues, optimizing production costs, rationalizing administrative expenses, minimizing financial losses, and so forth* .

The analysis of the rates of return and growth indicators has revealed that the beverage industry enterprises have considerably diminished their activity in 2014. While the light industry enterprises have registered an efficient increase since 2012, manifested by increased sales revenues accompanied by increased commercial profitability and increased total assets accompanied by increased economic profitability. A different situation is observed in the machinery industry, where the increase in sales and total assets is due to the decline in profitability indicators, which demonstrates the lack of performance in this branch. In this context, the author concludes that the financial performance of machinery, equipment and appliances enterprises can be enhanced by stabilizing measures such as increasing investment in innovation and enhancing enterprise cooperation with scientific centres within industrial clusters [3].

The complex nature of financial performance requires the research of its other aspect - the ***financial stability***, which reveals the financing structure of the company's and allows appreciation of the contribution of the financial policy to the achievement of the financial performance. The research of the financial stability indicators of industrial enterprises reveals that light industry enterprises show a higher degree of financial stability, but, according to the author, the increase in the degree of financial autonomy will allow for a high level of long-term financial performance. Also, the optimization of the financial structure is considered to be as a means of increasing the financial performance of the beverage industry and the car industry [18].

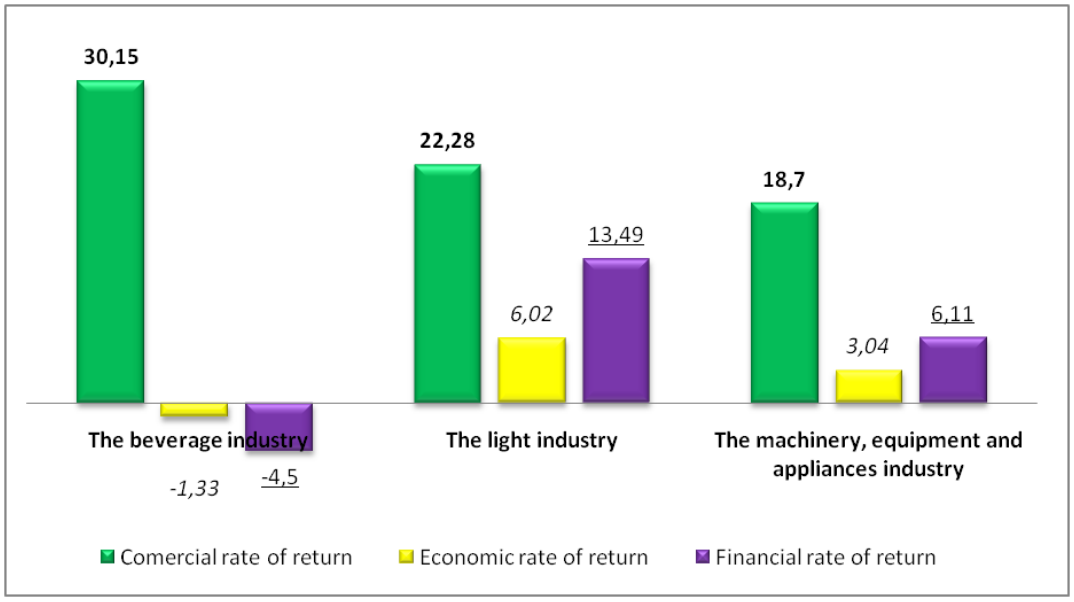

Figure 5. The comparative analysis of rates of return in period of 2010-2014, %
Source: Developed by the author based on data of the National Bureau of Statistics

The assessment of financial performance through liquidity ratios permits to estimate the companies' ability to pay. The results of the analysis show that both current and intermediate liquidity

ratios have recorded values within the unanimously accepted limits. However, the author generally recommends to raise the level of immediate liquidity ratio and, particularly, to raise the level of solvency ratio of beverage industry enterprises.

Equilibrium, in general, means a harmony between the components of a system, and from the financial perspective it involves the harmonization of financial sources with the financial needs of the enterprise. The analysis of the equilibrium ratios reveals that the light industry and machinery industries are more balanced, which contributes to a higher performance compared to the beverage industry, whose circulating capital is mostly financed by the working fund, which implies higher costs, affecting in the long run both the capacity to generate profit and the ability to pay [18].

The results of the analysis of the industrial enterprises' financial performance reveal that beverage companies have low level of financial performance caused by the strong indebtedness and low solvency, the inability of achieving a positive financial result. In addition, light industry enterprises are considered to be the most performant due to high profitability and efficient growth, while the financial performance of sales machinery, equipment and appliances enterprises has been compromised by inefficient growth, unstable results, declining profitability and financial autonomy.

Evaluating the financial performance of enterprises by the method of financial ratios has not provided a clear representation of overall financial performance, but rather it has showed the evolution of its dimensions. In this context, the author proposes another methodology for evaluating the financial performance based on the scoring method.

As a basis for this methodology, the model of US economist Piotroski J. "F-score" is taken. This model calculates an aggregate indicator of financial performance based on 9 binary financial criteria, grouped in three dimensions of financial performance: profitability, operational efficiency, solvency/ liquidity.

Thus, the author proposes the following conditions for the financial performance scoring model: 20 criteria grouped in 7 dimensions of financial performance (financial result, profitability, growth, stability, capital turnover, ability to pay and financial equilibrium) and a 5-point scale with clear logical conditions.

After awarding scores for 20 criteria, the overall level of financial performance is calculated by summing up the obtained results. The index can take values between 20 and 100 points and the level of financial performance can be attributed to one of the following categories: 20-40 points - non-performance; 41-60 points - low performance; 61-80 points - average performance; 81-100 points - superior performance [19].

The scoring model developed by the author offers the possibility to estimate the global level of financial performance and to distinguish performing and underperforming enterprises. Also, this model has an increased practical utility; in this sense, the author recommends it as a tool for diagnosing the financial performance of industrial enterprises in the forming the national development strategies of the industrial sector by the Ministry of Economy of the Republic of Moldova; as informational support for the managers in developing strategies and tactical plans and as a methodology for assessing the financial performance and identifying directions of its enhancing.

Applying the proposed model gives a clearer representation of the financial performance of the analyzed enterprises. Thus, the beverage industry is moving from a medium performance (77 points) to a weak performance (40 points), which is due to the impossibility of obtaining positive and growing net result, high indebtedness and the slowing of the speed of capital turnover.

The evolution of the financial performance of light and machine industries describes a non-uniform trend. Thus, if in 2012 the overall level of financial performance of light industry enterprises droped to a lower level, in 2014 it managed to achieve the highest level (92 points), due to the high financial results, the significant acceleration of the speed of capital turnover, increasing profitability and optimized financial structure.

The evolution of the machinery, equipment and appliances industry is more dramatic since it does not end with a significant increase. Thus, these enterprises have evolved from a superior level of performance (88 points), registered in 2011, to its lower level, taking only 59 points out of 100 possible. The decrease in financial performance is explained by the high indebtedness (62%),

accompanied by diminished financial results and profitability, as well as slowing down the speed of capital turnover [19].

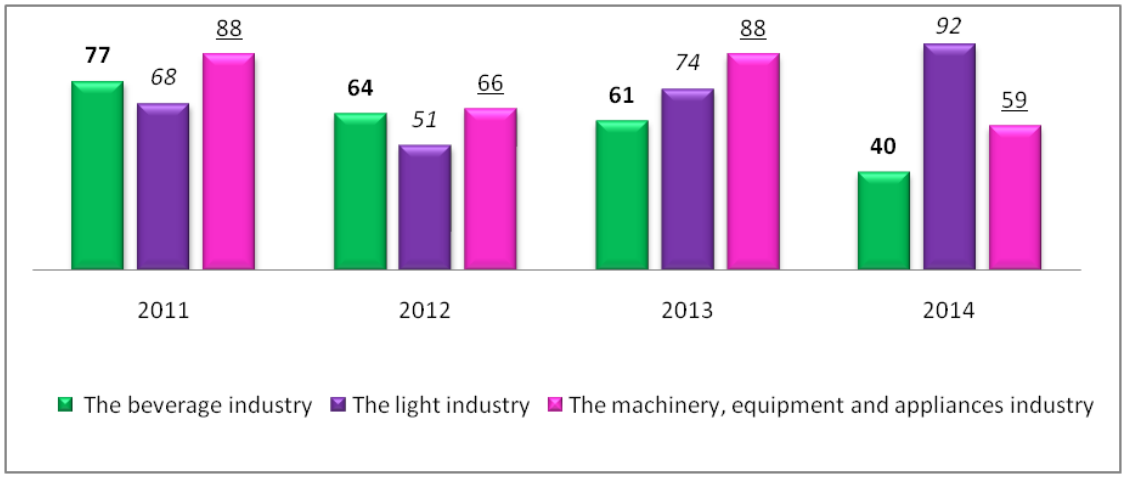

Figure 6. The comparative evolution of financial performance in period of 2010-2014
Source: Developed by the author based on own estimations

The ***capital turnover*** of a company is an extremely important dimension of financial performance because it has a significant influence on all its dimensions.

The comparative analysis of the capital turnover period of the industrial enterprises has revealed that the slowest rotation is registered in the beverage enterprises. In addition, based on the fact that beverage enterprises have registered the highest level of sales and the slowest turnover, author states that the beverage industry's enterprises do not use their entire productive and commercial potential, caused by the destructive influence of a wide range of internal and external factors. In the same context, the author finds that the capital of light industry enterprises has the shortest turnover period and a tendency of acceleration is observed. These results are considered to be determinants of the financial performance enhancement of the light industry enterprises. Moreover, a slowdown of the capital turnover speed has been registered in the machine industry, which has been caused by the increase in receivables' turnover period.

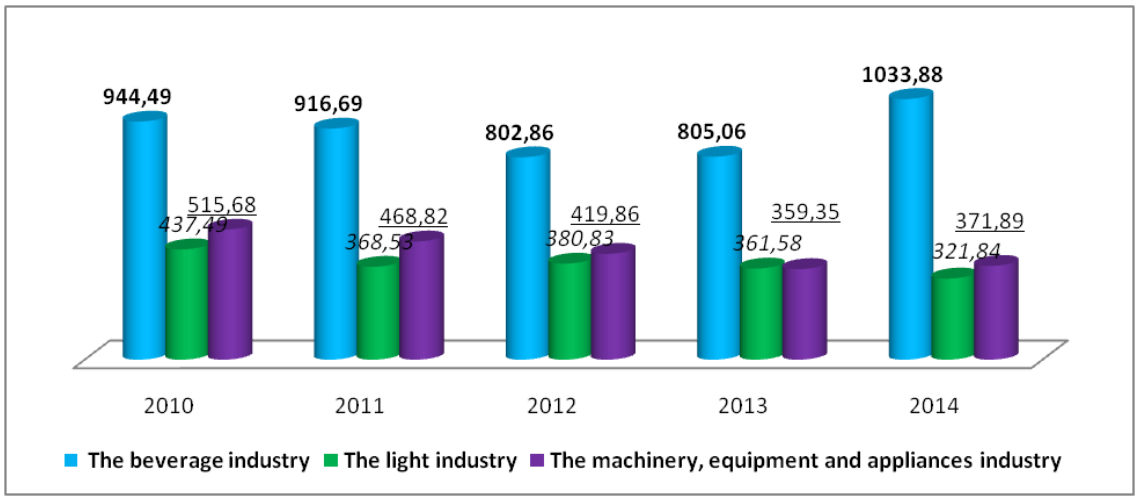

Figure 7. The comparative evolution of capital turnover period during 2010-2014, days
Source: Developed by the author based on data of the National Bureau of Statistics

The estimation of the capital turnover's effects through DuPont model, the factorial model of the financial result and the model of the cash conversion cycle has allowed the author to conclude the following:

• the slowdown of the capital turnover has led to a reduction in the financial profitability of beverage companies, while the acceleration of the capital turnover has had positive effects on the financial profitability of light industry enterprises, contributing to the highest level of profitability over the last 5 years. In the case of the machinery industry, the acceleration in speed of the capital turnover has showed a positive influence, diminishing the negative effects of reducing profit and increasing indebtedness.

• the slowdown in the turnover of the capital has affected the results of the light industry enterprises in 2012, the machinery industry enterprises in 2014, and the beverage industry enterprises in 2013 and 2014. The capital turnover has manifested as a positive factor for enterprises of the machinery industry, contributing to the growth of performance indicators in 2012 and 2013 and for light industry enterprises in 2013 and 2014.

• the beverage companies' ability to pay is compromised by the slowdown in the rate of rotation of receivables and stocks, while the machinery industry's enterprises have considerably extended the deferral of payments due to the slowdown in the receivables rotation, which has created additional risks for the ability to pay. In the same context, the acceleration of the receivables turnover speed is considered to have enhanced the ability to pay of the light industry's enterprises.

Generalizing the results, the author concludes that the capital turnover is a direct and determinant factor of financial performance. Enhancing the financial performance by the means of capital turnover acceleration, especially of the circulating capital, is considered to be a viable solution for the industrial enterprises.

The financial performance assessment methodology proposed by the author is elaborated using the non-linear regression technique based on the system of financial performance indicators, which includes 36 variables [5].

In order to reduce the number of independent variables, the ANOVA test and the bivariate correlation matrix were used. Logit and probit models were tested. As a result, the logit model demonstrated the higher ability to simulate the reality, with a total predictability of 74%. The result of the logit valuation is based on the aggregate index of financial performance, which takes values between 0 and 1, where "0" indicates that the probability of worsening of an enterprise's financial situation is 0%, which means that the enterprise is performant, while "1" indicates that the enterprise is unperformant.

The results of the simulations (table 2) reveal that the aggregate index for assessing the financial performance of industrial enterprises contains five relevant indicators: financial autonomy ratio, own working capital ratio, financial profitability, net profit/ share, price-to-book value ratio. The action of each of them is influenced by a range of internal and external factors that need to be traced and directed to the positive course of enterprise performance.

The aggregate index of financial performance is estimated by the following mathematical relationship:

$$(x) = \Pr(y = 1|X) = \frac{1}{1 + e^{-(4{,}34 - 3{,}62RAF - 1{,}05RFRP - 3{,}1ROE - 0{,}11PNACT - 0{,}08PBR)}}$$

where:

RAF - financial autonomy ratio; RFRP - own working capital ratio;

ROE - financial profitability; PNACT - net profit/ share;

PBR – price-to-book value ratio.

The estimation of the marginal effects of these independent variables on the financial performance denotes the following:

• The financial autonomy ratio (RAF) of a medium-sized enterprise determines, by 0.1 units, the increase in financial performance by 8.43%;

• The own working capital ratio (RFRP) of a medium-sized enterprise contributes by 0.1 points increasing the enhancement in the financial performance by 2.44%;

• The financial profitability (ROE) of a medium-sized enterprise, increasing by 0.1 point, increases its financial performance by 7.21%;

• The net profit/ share (PNACT) of a medium-sized enterprise, increasing by 0.1 points, will increase the probability of success by 0.26%;

• The "Price-to-Book-Ratio" (PBR) of a medium-sized enterprise determines by 0.1 percentage points the increase in financial performance by 0.18%.

Table 2. The results of the logit model

Dependent Variable: PF
Method: ML - Binary Logit
Sample: 2011 2014
Included observations: 172

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	4.342582	0.826609	5.253489	0.0000***
RAF	-3.624646	0.948105	-3.823042	0.0001***
RFRP	-1.050723	0.350771	-2.995465	0.0027***
ROE	-3.099125	1.612851	-1.921519	0.0547*
PNACT	-0.110815	0.038410	-2.885057	0.0039***
PBR	-0.077785	0.038917	-1.998742	0.0456**
McFaddenR^2	0.260187	Mean dependent var		0.540698
S.D. var. dep.	0.499796	S.E. of regression		0.419770
Akaike info criterion	1.090459	Sum squared resid		29.25038
Schwarz criterion	1.200256	Log likelihood		-87.77952
Hannan-Quinn criterion	1.135007	Restr. log likelihood		-118.6509
Restr. deviance	237.3018	Media funct. verosim		-0.510346
StatisticaLR	61.74280			
Prob(statisticaLR)	0.000000			
ObswithDep=0	79	Total obs		172
ObswithDep=1	93			

*p<0.1,**p<0.05,***p<0.01

Source: Developed by the author in EViews 8.0

Depending on the registered level of the estimated index, according to the relationship of the proposed model, the following categories of financial performance of the industrial enterprise are distinguished:

- ✓ "$0 \leq PF \leq 0.30$" - superior financial performance;
- ✓ "$0.30 < PF \leq 0.50$" - average financial performance;
- ✓ "$0.50 < PF \leq 0.70$" - low financial performance;
- ✓ "$0,70 < PF \leq 1$" - financial non-performance [5].

This assessment model, developed by the author, offers a number of advantages, including:

- It is an efficient tool for estimating financial performance and discrimination in performant and unperformant enterprises;
- It allows identification of the factors that contribute to or affect the financial performance;
- It is a true informational source for evaluating strategies implemented by an enterprise.

In addition, author believes that aggregate index model of the financial performance will be helpful for the following users of financial information:

- ***Enterprise managers*** can use this model to develop and evaluate enterprise strategies and

competitive environment;

- ***Financial managers*** can enhance the quality of their financial policy by matching its components (financing policy, dividend policy and investment policy) with the real level of financial performance;

- ***The National Financial Market Commission*** can use this model as an effective tool for monitoring the financial situation of professional participants in the capital market, while giving current and potential investors a clear picture of the company's financial condition.

- ***Commercial banks*** can use the aggregate financial performance index to assess the creditworthiness of customers.

- ***Academic researchers and other research organization*** can use this model to carry out various research studies.

By generalising the results of the financial performance assessment, author concludes that financial performance is conditioned by uncompromising financial autonomy, the existence of positive working capital, increasing profitability and stock exchange rates as the result of efficient capital management. An equally important consideration is that efficient use of capital has to be improved, first of all, by accelerating capital turnover, avoiding capital immobilization in different phases of the economic and financial circuit.

World theory and practice recognise the importance of capital turnover for the prosperity of an enterprise. However, the existing models for estimating the effects of the capital turnover have focused on assessing the relationship of capital turnover with performance dimensions, but not on financial performance as an integral concept. In this context, the author proposes a methodology for assessing the effects of capital turnover on financial performance, based on two key ideas:

1. In assessing the influence of the financial performance factors, its complex and multidimensional character must be taken into account. In light of this, the author proposes the aggregate index of the financial performance estimated by means of the logit regression technique as a dependent variable;

2. As the economic capital is considered to be a system and its turnover a systemic process characterized by interdependent relations between its components, the author proposes the use of indicators that will reflect both isolated and systemic effects of the capital turnover on financial performance. Thus, the author suggests to use the following detailed factors of the capital turnover: *the turnover period of the tangible assets (RIC), the stock turnover period (RS), the receivables collection period (RC), the cash turnover period (RN), the „tangible-to-total assets turnover period" ratio (RICRAT), the „stock-to-total assets turnover period" ratio (RSRAT), the „receivables-to-total assets turnover period" ratio (RCRAT) and the „cash-to-total assets turnover period" ratio (RNRAT).*

The panel data regression was chosen as a simulation technique. The research sample included enterprises of the wine industry, light industry and machinery, equipment and appliances industry. The results of repeated simulations revealed the following at a statistically significant level:

- The aggregate financial performance index is influenced by the „cash-to-total assets turnover period" ratio (RNRAT);

- The financial autonomy ratio (RAF) is influenced by the „receivables-to-total assets turnover period" ratio (RCRAT);

- The own working capital ratio (RFRP) is influenced by the „tangible-to-total assets turnover period" ratio (RICRAT) and the „cash-to-total assets turnover period" ratio (RNRAT);

Apart from the "Price-to-Book-Ratio" (PBR), this is not statistically sensitive to the variables of the capital turnover [22].

Therefore, combining the research results with the concepts of DuPont model and factorial model of financial results, the author concludes that both financial performance and its dimensions are influenced by the capital turnover with the exception of "price-to-book" ratio.

The simulation of capital turnover effects on the financial performance by the means of the panel data regression technique has shown the following results:

a) An increase of the systemic indicator „*cash-to-total assets turnover period" ratio* determines an enhancement of the financial performance;

b) A reduction of the systemic indicators *„tangible-to-total assets turnover period" ratio (RICRAT)* and *„receivables-to-total assets turnover period" ratio (RCRAT)* contributes to an increase of the financial performance.

Conclusions

Researching the correlation between capital turnover and financial performance from both quantitative and qualitative perspectives reveals that the following cases will contribute to increasing financial performance:

- *The increase of the RNRAT indicator is determined by the faster acceleration of the total assets turnover than the acceleration of the cash turnover;*

- *The reduction of the RICRAT and RCRAT indicators is based on the slower acceleration of the total assets turnover than the acceleration of the tangible assets turnover and the receivables turnover.*

Thus, the author concludes that the necessary conditions to be present regarding the interdependence between the turnover of the economic capital and the turnover of its elements in order to increase the financial performance are the following [22]:

1. *The turnover of total assets, tangible assets, receivables and cash should accelerate;*

2. *The turnover of tangible assets and receivables must exceed that of the economic capital (total assets);*

3. *The turnover of the economic capital must be higher than the cash turnover.*

At the same time, the author considers important to emphasize that *the acceleration of the economic capital turnover will have the greatest positive effect on financial performance when it is determined by the higher increase of the revenues than the increase of the average value of the economic capital*.

Thus, *sales revenue should grow at a higher rate than the average economic capital*. At the same time, *the average value of tangible assets and receivables should increase at a slower pace than the average of the capital as a whole*, and *the average value of cash should rise at a higher rate than the economic capital.*

Therefore, in order to increase the financial performance of industrial enterprises the following conditions have to be respected:

a) Revenue from sales increases significantly;

b) The increase of sales must lead to the cash growth rather than that of the receivables;

c) The increase in cash must not lead to an excessive level of liquidity;

In the context of the obtained results, the author identifies the following directions for increasing the financial performance through the acceleration of the capital turnover:

1. Improvement of the company's commercial policy, which will ensure a continuous and significant increase in sales revenue. Proposed measures:

a) Elaboration of the sales program in accordance with the general objectives of the company, taking into account the distribution channels and the sales' factors of influence;

b) Coordination of the production activity with the elaborated sales program, so that the scheduled demand is covered by the company's offer of products;

c) Strengthening the sales system, diversifying the distribution channels;

d) Promoting the brand of enterprises and branded products through various methods (positioning of the company brand and product uniqueness, TV advertising, magazines, internet, increasing the visibility through the company's web site and social networks page);

e) Increasing distributors' and customers' loyalty through promotional techniques (grouped sales, discounts, contests, lotteries, etc.)

2. Optimising customer management to accelerate collection of receivables, which can be achieved through the following activities:

a) *Determining the maximum acceptable level of receivables on the basis of the sales program* will avoid the increase of receivables at a rate higher than the increase of the sales revenues;

b) *Analysing the receivables by customer groups* according to their importance for the enterprise and their credit history;

c) *Current controls of receivables* by the means of a registry, classifying them according to the collecting period;

d) *Developing a well-defined lending policy* containing clear provisions on the conditions for granting and receiving commercial credit for all categories of clients based on solvency standards*;*

e) *Applying a trade discount system* to encourage customers to pay as quickly as possible.

f) *Use of debt re-financing techniques* (e.g. factoring).

3. Increasing the efficiency of liquidity management through the following measures:

a) *Prognosis of receipts according to the sales schedule, and payments according to the exigibility of the current obligations;*

b) *Monitoring and synchronising cash inflows with cash outflows*;

c) *Determining and controlling the current cash flow* according to:

- The amount of current debts in order to comply with the optimum level of liquidity rates;
- The capital turnover indicators. The cash turnover should accelerate and it should be higher than the growth rate of the average value of the economic capital, of the tangible assets and of the receivables.

d) *Forming and optimizing the information base on cash flows, cash balance*;

e)*Increasing the efficiency of cash surplus management* by checking current cash balance is at optimum level, use of short-term investment banking products and other banking services to facilitate cash management (web-business or corporate-banking, mobile signature and so on .).

4. Streamlining the investment policy of the enterprise with a view to a balanced combination of investment in tangible, intangible and financial assets. The results of panel data regression have revealed that the excessive increase in tangible assets affects financial performance. In this context, the author proposes the following:

a)*The realization of investments in tangible assets must be directed to innovative projects, to modernization*, which will contribute to increasing the competitive advantage of the enterprise;

b)*Current control of the growth rate of the average value of tangible assets* by comparing it with the growth rate of sales revenue and of economic capital (the growth rate of tangible assets must be lower);

c)*Re-dimensioning investment policy* including and using such components as investment in intangible assets, financial assets and short-term investments. Investments in intangible assets must be directed towards the purchase of intellectual property, which will enhance the innovative development of the enterprise, the quality of manufactured products, and so on. Investments in financial assets are an alternative to investment in tangible assets because they are divisible, have a higher liquidity degree, are not depreciated. Short-term investments in the form of bank deposits with right to replenish and withdraw to the customer's need are a useful way of equilibrating the risk-profitability relationship. Thus, the enterprise avoids additional costs resulting from excessive cash holdings and the risk of inability to pay immediate bonds.

In conclusion, the author notes that the capital turnover is a determinant of financial performance, the influence of which is significant and positive. Based on empirical research, the author finds that capital turnover influences financial performance not only through isolated, but also systemic effects. Thus, the author concludes that it is not enough for capital turnover just to accelerate; a correlation between the turnover of economic capital and the turnover of its components has to be maintained. In addition, the author finds that if the tangible assets turnover and the receivables one accelerates faster than the capital turnover (total assets), the financial performance will increase. In the same time, capital turnover acceleration rate must be higher than that of cash. And finally, in conclusion, *the capital turnover has positive effects on the financial performance* when *the turnover accelerates, being determined by a faster growth of sales compared to the increase in the average capital value.*

REFERENCES:

1. Bashir Z.ș.a. Empirical Investigation of the Factors Affecting Firm's Performance: a Study Based on Food Sector of Pakistan. În: International SAMANM Journal of Finance and Accounting, Vol.

1, No. 2, 2013, p.11-23. ISSN 2308-2356
2. Bhatti W. ş.a.The Role of Intellectual Capital in Creating and Adding Value to Organizational Performance: A Conceptual Analysis. În: The Electronic Journal of Knowledge Management, 2014, Volume 12 Issue 3, p. 187-194.
3. Botnari N. Nedelcu A. Evaluarea performanţei financiare a întreprinderilor industriale prin prisma dimensiunilor de profitabilitate, rentabilitate şi creştere. În: *Economica*, ASEM, 2015, nr. 3 (93), 2015, 0,56 c.a. p.49-59. ISSN: 1810-9136. Categoria B.
4. Botnari N. Nedelcu A. Estimarea efectelor rotaţiei capitalului asupra performanţei financiare a întreprinderilor industriale. În: *Economica*, ASEM, 2015, nr. 4 (94), 2015, 0,80 c.a. p.72-87. ISSN: 1810-9136. Categoria B.
5. Botnari N. Nedelcu A. Onofrei M. Modelarea econometrică a performanţei financiare a întreprinderilor industriale – studiu de caz: industria uşoară,vinicolăşi a maşinilor. În: Economie şi Sociologie nr.1, 2016, p. 103-112, 2016, 0,69 c.a. ISSN: 1857-4130. Categoria B.
6. Cannan E. Early history of the term capital. În: Quarterly Journal of Economics volume 35 (1921), http://socserv2.socsci.mcmaster.ca/econ/ugcm/3ll3/annan/cannan002.html(vizitat 12.08.2012)
7. Clark, J.B. The Distribution of Wealth: A Theory of Wages, Interest and Profits, New York: Macmillan, 1908. http://oll.libertyfund.org/titles/329 (vizitat 13.08.2012).
8. Figueiredo L. ş.a. The relative importance of total factor productivity and factors of production in income per worker: Evidence from the Brazilian states. În: EconomiA 17 (2016) 159–175
9. Fox J. "Understanding Capital Volume II", Progress Books, Toronto, 1985. https://www.marxists.org/subject/economy/authors/fox/ (vizitat 07.08.2012)
10. Groenewegen P. "Fixed capital as a problem in joint production, some historical considerations", În: Capital controversy, Postkeynesian economics and the history of economic thought", Essays in honour of geoff harcourt volume one, London and New York, 1997, p.64-74.
11. Jevons, W.S. "The Theory of Political Economy", London: Macmillan, 1888. http://www.econlib.org/library/YPDBooks/Jevons/jvnPE.html (vizitat 08.08.2012)
12. Mill, J.S. "The Collected Works of John Stuart Mill, Volume II - The Principles of Political Economy with Some of Their Applications to Social Philosophy (Books I-II"), ed. John M. Robson, introducerea de V.W. Bladen, Toronto: University of Toronto Press, 1965. http://oll.libertyfund.org/titles/102 (vizitat 05.08.2012).
13. Mugiati A. An Analysis of Factors Affecting the Company Performance in Creating the Competitiveness of Furniture and Printing Small-Sized Enterprises in Jayapura City. În: Journal of Social and Development Sciences, Vol. 6, No. 1, 2015, pp. 46-55, ISSN 2221-1152.
14. Nedelcu A. Capital as factor of production: evolution and perspectives. În: Simpozionul Ştiinţific al Tinerilor Cercetători, Ediţia a XII-a, vol. I, 4 – 5 aprilie 2014 ASEM, Chişinău, p.74 – 80, 0,59 c.a. ISBN 978-9975-75-689-1.
15. Nedelcu A. Performanţa întreprinderii în abordarea multidisciplinară. În : Conferinţa Ştiinţifică Internaţională „Politici şi mecanisme de inovare şi dezvoltare a proceselor economico-financiare şi sociale în plan naţional şi internaţional", din 31 octombrie 2014, ediţia a IX-a, Universitatea de Stat a Moldovei, 0,44 c.a. 2014, p.186-190, ISBN 978-9975-71-574-4.
16. Nedelcu A**.** Delimitări conceptuale privind performanţa financiară a întreprinderii industriale. În: Analele Universităţii de Stat „B.P. Hasdeu" din Cahul, Volumul X, 2014, 0,35 c.a. p.228-231, ISSN 1857-2170.
17. Nedelcu A. Rotaţia capitalului – expresie a performanţei financiare a întreprinderii. În : Conferinţa Stiinţifică Internaţională dedicată aniv. 20 ani a învăţământului economic la Universitatea de Stat Alecu Russo din Bălţi: Aspecte ale dezvoltării potenţialului economico - managerial în contextul asigurării securităţii naţionale din 6-7 iulie 2015, Secţiunile 4-6, Bălţi, p.125-130, 0,05 c.a. ISBN 978-9975-132-35-0.
18. Nedelcu A. Evaluarea performanţei financiare a întreprinderilor industriale prin prisma dimensiunilor de stabilitate, capacitate de plată şi echilibru. În: Conferinţa Ştiinţifică Internaţională „Priorităţi strategice de modernizare inovaţională a economiei Republicii Moldova

şi politici de dezvoltare durabilă la nivel mondial", ediţia a X-a, Universitatea de Stat A Moldovei din 30 – 31 octombrie 2015, p.256-263, 0,41 c.a. ISBN 978-9975-71-711-3.

19. Nedelcu A. Evaluarea performanţei financiare a industriei prin metoda scoring cu punctaj. În: Conferinţa Ştiinţifică Internaţională „Competitivitatea şi inovarea în economia cunoaşterii": Culegere de articole selective, ASEM din 25 – 26 septembrie 2015, p. 231-238, 0,61 c.a. ISBN 978-9975-75-714-0.
20. Nedelcu A. Evaluarea performanţei financiare ca componentă esenţială a managementului performanţei. În: Conferinţa Ştiinţifică Internaţională „Potenţialul de finanţare al pieţei financiare nebancare şi persoectivele dezvoltării acesteia", ASEM din 27-28 noiembrie 2015, p.283-p.288, 0,32 p. ISBN 978-9975-3018-4-8.
21. Nedelcu A. Metode de evaluare a performanţei financiare a întreprinderilor industrial. În: Национальная научно-практическая конференция, 11 декабря 2015, Комратский Государственный Университет, Комрат, p. 35-42, 0,40 c.a. ISBN 978-9975-3106-1-1.
22. Nedelcu A. Sporirea performanţei financiare a întreprinderilor industriale prin accelerarea vitezei de rotație a capitalului. În: Studia Universiatis Moldaviae, nr.2 (92), 2016, 0,56 c.a. p. 236-243, 2016, ISSN 1814-3237. Categoria B.
23. Smith, A. An Inquiry into the Nature and Causes of the Wealth of Nations , editat de Edwin Cannan, London: Methuen, 1904. http://oll.libertyfund.org/titles/171 (vizitat 04.08.2012)

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THE VENTURE CAPITAL IN MODERN INNOVATIVE BUSINESS: OPPORTUNITIES AND PROSPECTS FOR THE REPUBLIC OF MOLDOVA

MIRON OXANA,
Doctor of economic sciences, Associate Professor
Cahul State University „B.P.Hasdeu"
E-mail: oxana1677@mail.ru

Abstract: *The article provides a mechanism for the application of venture financing of innovation projects in accordance with the phases of the innovation process. The indicators of the effectiveness of combined investment with venture capital were uncovered. It should be noted that there is a need to organize the work of participants in venture investing in a single system with specific performers in priority research projects. Also, this article describes the institutional mechanism of interaction of venture investors with innovative enterprises that have involved venture capital at various stages of development. The directions of attracted investment to create long-term competitive advantages have been identified. A detailed analysis of the key points of the post-investment phase was carried out. There were examined and identified the need and the possibilities for infrastructure-building and macroeconomic conditions for attracting venture capital investment from the Republic of Moldova at the national and regional levels.*

Keywords: *Innovation, venture capital investments, post investment phase, innovative enterprise, venture capital, innovation activities, phases of the innovation cycle, risks of venture capital, venture infrastructure.*

JEL: G24, G31, O31
UDC: 334.72 (478)

Introduction

The limitations of traditional forms of financing of innovation activity of economic entities are optimized such innovative form as venture capital.

The analysis of the etymology and of the economic content of the term "venture capital" showed its organic relationship with the financial capital structure while the general thrust is rather heterogeneous. At the time of its occurrence, the financial capital included the following components - banking and industrial capital.

Historically, the financial capital, subject to certain conditions, was only in monetary form. The time has shown that the specificities of this category is that its enrichment associated with the appearance of new financial forms of capital, which in turn depend on the development not only of banking and industrial capital, but other forms and markets (for example, fictitious capital and the stock market).

Currently, continues the transformation of financial capital, turning it into a special type of capital, which includes all kinds of capital, including the commercial capital, formed not only through funding the monopolies, but also through the middle and small capital. The financial capital incorporates elements of this type of capital, such as human capital, resulting in the granting of investors, not just cash, but also economic, organizational and managerial aptitudes (management skills, experience, business, etc.). This occurs under conditions of high uncertainty and risk of funds' loss. The investment of human capital, imply investments of health, abilities, knowledge, skills, human motivation (investor or hired them) at some innovative project.

As a result, there is a peculiar symbiosis of financial and human capital - venture capital, ensuring effective use of innovations and specific needs of the innovation process.

Originally, the meaning of „venture capital", which was closely appropriate with the meaning of the word „venture" (Engl. „venture"), which, on the one hand means the enterprise and, on the other hand, risk. The study of the basic theoretical and methodological approaches to the definition of categories of capital, highlighting its main characteristics, consideration of types of capital in their relationship-showed the versatility and complexity of the concept of „venture capital", that in our opinion is preclude its common interpretation. [6]

Analysis of recent researches and publications

On the basis of the analysis of existing definitions of the term "venture capital", it is possible to identify two major approaches: American and European.

The American interpretation of the notion „venture capital" is narrow. In the United States under venture capital is understood only what works in the early stages of becoming a high-tech company. The National Venture Capital Association (NVCA) of the United States has identified „venture capital" as equity provided by professionals in the field who provide management support for young, fast-growing companies with significant potential competitive development.

From the perspective of the American economist, governor of the „NGC investment", J. Nuechterlein, venture capital is a company's financing in the early stages, as opposed to the acquisition of a controlling stake in the company or its diversification. According to the American approach, transaction type MBO/MBI (management buy-out-redemption of external managers; management buy-in is repurchase internal managers) must not include venture capital. The venture capital is understood as a form of direct investment. [8]

The European interpretation of venture capital is enhanced. In Europe, the term includes all types of equity investments at all stages of the development of small and medium-sized companies that use high technology and is not quoted on the stock market. Venture capital investments in Europe include unconventional buyback transaction type, using credit resources, investments in companies located in non-satisfactory financial situation (problem companies), and the initial public placement of securities (IPO). Thanks to such a broad definition, venture capital investments in Europe sometimes even equated with private capital investments, which are any investments in private closed company. [8]

In the United States deals with the use of credit, investments in distressed companies and IPO decided to no venture capital sector. However, the approval of American specialists that governing interest in working with venture funds developed companies relates only with a reduction in overall risk of investments, it is not quite correct. The high-risk element is stored in the work with developed companies, because in most cases it is associated with the innovations of organizational and management plan. [12]

The aim of the article

This study was undertaken in order to identify opportunities for the development of Moldavian business, especially for new small businesses with promising ideas and low levels of funding. Through the analysis of the experience of European countries and the United States in assisting small businesses with innovative ideas, it is expected to identify possible ways of establishing prerequisites and favorable conditions for attracting investors in the national economy, features of business angels and venture capitalists by creating relevant legislation and public venture funds in the Republic of Moldova.

Research results

In line with this study, we adopted the European interpretation of venture capital by virtue of the specific economic and political situation of the Republic of Moldova. Because risk is innovative financing of enterprises not only in the early stages of development but also of enterprises operating at the stages of the innovation business expansion, restructuring, transformation and diversification.

The venture capital, from the point of view of the author, is financial-credit form ensure innovative interaction between real and financial sectors of the economy, represents the totality of economic relations of economic agents, the formation and utilization of financial resources and entrepreneurial capacities of specialized innovative investor, devoted to the implementation of innovation in order to obtain high profits or other effect.

The analysis showed that with all the variety of definitions of venture capital, there is a problem with the system definition and presentation of venture financing of innovation economic agents interaction real and financial sectors economy. In our view, the study of essence and disclosure of venture capital should be in conjunction with the development of objects about which a venture financing appears, as well as implementing agents. We are talking about the specifics of innovative interactions, managing subjects real and financial sectors of the economy that provides the origin and the development of venture capital relations. In the Figure 1 it is presented a scheme for financing innovative interaction through a phased application of venture capital for innovative processes.

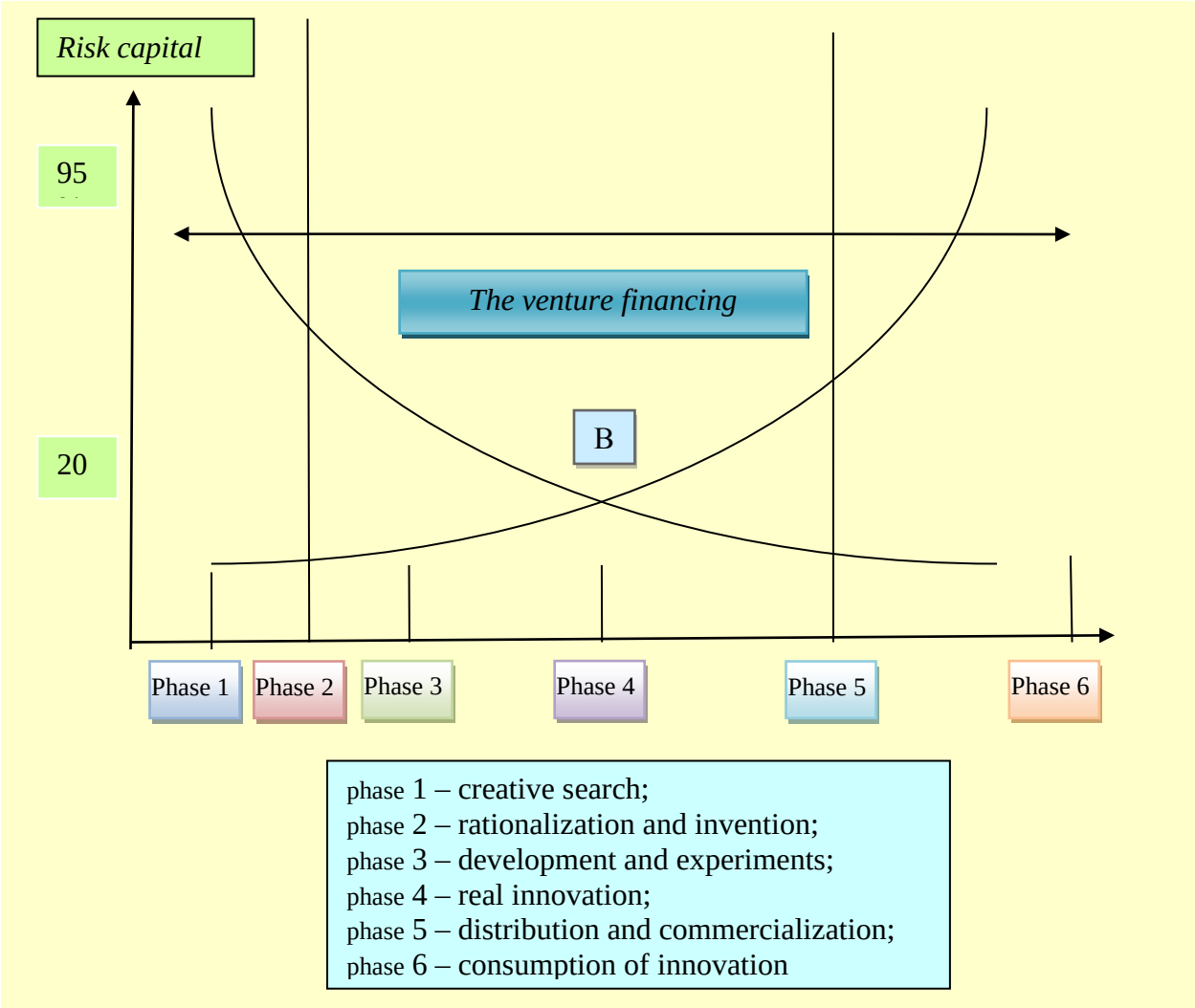

Figure 1. The possibility of a phased application venture form, financial and credit support of the innovation cycle.

Source: adapted by the author Vagizova V.I. The venture capital Management in today's innovative business: opportunities and prospects. National interests: priorities and security. 36 (177)-2012. LLC „Finance and credit" Publishing House, Moscow. ISSN: 2073-2872.

As can be seen from the analysis of the Figure 1, innovation processes are generated in a creative phase of fundamental science, in phases of production and market, are transformed in phases the recycling processes data results in the tradition. Ideally, the result of a venture capital campaign should be manufacturing prototype (point B). From that moment carried out standard algorithm of investment and value analysis and organization of serial production. Right curve shows that the relative costs of venture capital, in case of mass production of two orders of magnitude equal to or greater than similar investments in basic science.

The fundamental principles of venture funding are:

- market mobility and adaptability;
- localization and diversification venture portfolio;
- differential and integrated investment.

The analysis of foreign and domestic practices of venture financing for innovative interaction between economic agents revealed that the real rate of return of the whole venture portfolio in conditions of perfect competition is usually from 39 up to 63% (with inflation at about 4%), which significantly exceeds the efficiency of investment in other sectors of the economy.

The contribution of the funds invested in venture financing company in the middle of the XX century was: financial management - 44%; corporate strategy - 43%; exchange of ideas - 41%; marketing - 33%; discussion of current issues - 32%; selection of managers - 10%; the other is 7%.

Let's look at the key setting of innovation-active countries depending on the proportion of venture capital in the economy. The estimates about the state of venture capital in fractions of GDP in different countries of the world were as follows: United States - 1%; United Kingdom – 0,8%; France – 0,3%; Germany – 0,2%; Japan – 0,05%.[10]

Since innovative projects and programmes are unique, highly risky, high-cost and long-term investment objects, it is recommended to use the mechanisms of their mixed, combined traditionally innovative financing. The combined traditionally innovative financing, the investor will compensate the costs when implementing one of the innovative project proceeds from the previous draft.

The number of innovative projects in the combined system, should be determined by the ratio of budget innovation of an entity for a specific time period to the average cost per project. Based on this evaluation, formed the innovative package that should include a variety of „risk -income" innovative projects, which are essential for economic diversification and efficiency financial and economic indicators, taking into account the degree of risk.

The notion of risk is an indispensable component of the category „venture capital" and directly associated with the notion of expected profitability of venture capital investment. The greater the magnitude of the risk is, that venture investor assumes when implementing an investment project or financing companies, the greater income he has, which he hopes when implementing the financing, and the more shares that venture investor will require as collateral invested in venture funds.

The risk factors may be, as the early stage of development of the business entity, and the overall condition of the development of economic activity in the region and the state of the economy as a whole. The classification of risk venture capital is represented:

Phase: ***The occurrence in the capital of invested enterprises.***

a) The risk of unproduced investment - Incompatibility with the economic, social and technological societies;
b) The risk of alternative capital application - Mistakes in the strategy of innovative development, ignoring the traditions

Phase:***The occurrence in the capital and monitoring.***

a) The risk of future losses of an entity - Industrial, technological and managerial risks
b) The risk of depletion of investment resources - Late score turning innovation into tradition

Phase:***The exit of capital (the realization of investments)***

a) The risk of financial insolvency of venture investment - Financial risk, lack of co-ordination of interests of participants
b) The risk of the need for new investment and exit delays capital - Updated way of economic system

The risk environment investment venture investor, is closely associated with a category of income, embodying the specificity of venture capital, expressed the principle of „risk-income", that, as shown in the table 1, distinguishes it from bank financing or funding for a strategic investor.

When implementing the venture investor, there are the following features:

- firstly, venture financing is impossible without principle „approved risk". This means that investors predict in advance the possibility of losing funds under the high risk funded by businesses in exchange for a higher rate of return in the case of its success;

- secondly, venture financing involves long-term investment capital, in which the investor plans the term investments in average from 3 to 5 years to ensure the prospects of the project, and from 5 to 10 years to make a profit on invested capital;

Table 1. The Difference of venture financing from other types of financing

The sources of financing	Banks	Strategic investors	The venture financing
The equity investment	-	+	+
The loans	+	-	+
The long-term investments	+	+	+
Venture business	-	-	+
The participation of investors in the management of the firm	-	+	+

Source: Vagizova V.I. The venture capital Management in today's innovative business: opportunities and prospects. National interests: priorities and security. 36 (177)-2012. LLC „Finance and credit" Publishing House, Moscow. ISSN: 2073-2872.

- thirdly, risk financing is placed not as a loan, but in the form of a shareholding in the share capital. Newly established entities usually use the legal status of partnerships, and investors are becoming partners with them in the limited size of the deposit. Depending on the level of participation, which is stipulated in the provision of money, risky investors have the right to receive appropriate future profits from company that financed them;
- fourthly, venture entrepreneur, in contrast to a strategic partner, rarely aspires to ownership of a controlling stake in the company. Usually the shares are approximately to 25-40%;
- fifth, the high degree of personal investor interest in the success of the new venture. This follows both from the high risk of the project and the status of co-owner established venture. So, the risk investors are often not limited to provide funds and provide various consulting, management and other services. [12]

These features can be seen in the process of venture financing of innovation the interaction of businesses, which includes several stages (table 2). Their number and the duration depend on what stage of life cycle of innovation will be the venture funding. With each stage venture funding, communicates its institutional type of venture capital market in the sphere of circulation of securities.

Table 2. The stages of venture financing for innovative interaction of economic entities

The title of stage's interaction	The content of stages of venture financing
Before the start	*First stage.* Prelaunch capital-funding required for the preparation of feasibility implementation of innovations. Initial capital-industrial design innovation and production of pilot lot; funding needed to start production
The financing for the expansion and development of business entity	*Second stage* – presentation of the working capital to maintain the initial growth; the lack of profits. *Third stage* – the company's expansion, growing sales, achieved self-sufficiency. *Fourth stage* – transitional funding for the preparation of the company's restructuring into a joint-stock company
The way out of the capital of an entity	*The Traditional purchase of shares* – acquisition of ownership of the new company and transfer it under its control. Privatization is the opportunity to purchase shares of the owners or managers of the company.

Source: Katherine Kampbell. Smarter Ventures: A Survivor's Guide to Venture Capital Through the New Cycle Paperback – Illustrated, 4 Sep 2003, Business Books 2004. – 337 p.

In the domestic economy on the cost-effectiveness criteria of venture capital there are shortcomings that should be addressed. So, if the European venture capital is increasingly capital development system, the domestic economy can be described as a capital restructuring. There is significant scientific and technological separation from the world average level in some sectors. A substantial amount of venture capital investments in developed countries is made on the basis of large industrial enterprises which possess the technological, stock, technical, intellectual, financial and credit support.

Their transfer channels ensure interoperability and harmonization of market needs and innovative features. In addition, the prevailing form of domestic investment will not affect high-tech economic activities, limiting the formation of national competitive advantage.

Among the positive factors for the development of venture investment in the domestic economy should include:

- availability of projects, brought to the stage of commercial use. In some cases running such projects requires a relatively small proportion of own investments, the remainder of the required funding could be loaned funds;
- a significant number of projects with significant export potential, which greatly facilitates the task of attracting the necessary financial resources;
- high qualification of personnel.

At the same time, modern domestic economy present circumstances, limiting the development of venture business in Moldova. Many of them stem from macroeconomic causes, as well as the lack of co-ordination of interests of economic subjects real and financial sectors of the economy. In addition, in many projects, develop incentives for investors, are neglected. Mainly accents are made on the technical merits of innovation, ignoring the interrelationship of the innovation process with financial and credit provision, are not used sufficiently the possibilities of large industrial enterprises for the development of innovative relations in the economy.

The analysis shows that the distribution of projects by areas of activity occurs are directly proportional to the degree of innovation and attractiveness of priority of this industry.

At the same time, the purpose of venture financing of innovation is the harmonious development of all sectors of the regional economy, including consumer market, medicine, communications, electronics, information technologies, Bioengineering-and on this basis already receiving communicative synergies. Given the nature of the business venture, results-oriented budgeting, more revenue compared with alternative directions of capital investments, it should be noted that the venture investor is indifferent to a certain extent, in what sector production to invest. It is important to have a guaranteed income and benefits on their investments. In this regard, the need for harmonization is brewing and a combination of the interests of the development of certain economic activities generating income interests venture investors in the future. To this end, it is necessary to explore the possibilities of a negotiated innovative economic agent's interaction real and financial sector of the economy, carrying out implementation of venture capital for innovative processes.

Thus, innovative processes and their financing through venture capital needed to be further improved, including in the Republic of Moldova, which must be in the following areas:

- the establishment of a center of responsibility for the management of venture capital investments;
- formation of motivation of large and small business entities to implement their innovative capacity;
- the finance and credit, institutional support for innovative interaction between economic entities of the real and financial sectors of the regional economy;
- innovative development of science by region.

A positive moment can be considered the creation of the Agency in the Republic of Moldova on innovation and transfer of technology under the Academy of Sciences, created by decision of the Assembly of the Academy of Sciences of Moldova no. 8 of 29 October 2004, which must accumulate the innovative projects, ready to invest. [7]

The organization of public-private partnership among venture investors, attract private capital in innovation can be solved through the establishment of venture capital funds formed by public and private funds.

There is sufficient evidence of a positive impact of venture capital investments for the development of small high-tech innovative enterprises. These facts provide a catalyst for the growth of portfolio companies, increase sales volume and employment.

European Venture Capital Associations (EVCA) studies showed that 90% of companies in the expansion stage without venture capital would not have survived or would develop more slowly, while 72% of companies in the early stages of development wouldn't come out on the market [11]. Providing investment, order 2/3 venture capitalists assume that post investment phase will last 2-5 years, about 20% are willing to wait for the refund money 6-7 years. The minimally acceptable level of IRR almost without deviation is within 35-40%.

According to EVCA, portfolio companies using attracted investment to create a long-term competitive advantage spend them in the first place: - Research and Development, R&D; -marketing; -training of personnel. It should be noted that companies in the early stages, invest in Research and Development, R&D (so, half received investment companies increased the article costs more than 4 times) and at the stage of expansion is in marketing. Such a layout is logical, because companies in the early stages involved in the development and improvement of products and at the expansion phase the sales are most important. The staff costs in both groups of companies doubled.

Among the most important factors for the increase in the value of portfolio companies, we can distinguish the following four :

- sustainable cash flow generation;
- development of a new product;
- the conquest of the market share;
- the use of high-quality staff.

Moreover, the high priorities among all companies receive the following activities: creating a recognizable brand, optimization and costs control. At the same time, attention to the question of the expansion of the product line and improve the quality of business processes, it was more common for companies in the expansion stage, while in the early stages of more emphasis on the development of business models and improve product quality.

It should be noted that the hallmark of venture investor capital from other sources is non-financial support. During the expansion phase of portfolio companies do not underestimate the value of non-financial support, however, appreciate that the venture investor is the guarantor of their reliability. The combination of financial and non-financial support leads to a significant increase in turnover and profit of portfolio companies.

For companies in the early stages it is natural growth of turnover of 200% in the first year and on average 120% per year over the next three years. For companies in the expansion stage, the rate is lower, but 33%-quite a good result.It is noteworthy that the number of employees increases for several post investment years an average of 46 people, provided that prior to the receipt of investment most companies in early stages is less than 6 people. The profit of companies in the early stages in the first years of life is strictly negative. This is logical, because of high proportion of costs. Portfolio companies at the stage of expansion by the end of the third year from the date of receipt of the investment show a steady increase in profits with 1.2% to 4.4% of turnover [11].

On the change of turnover and profits, many factors are involved, so for a more objective assessment of the contribution of venture investor at post investment stage, let's compare the portfolio company with their main competitors. Nearly 90% of companies that have received investment noted that growth in their turnover was nothing less than competitors, and 57%-that is more, 77% of portfolio companies could make a profit no less than competitors.

Next, take a look on the mechanism of interaction of small innovative enterprises with venture capitalist in the field of non-financial support. In addition to capital portfolio company can expect from a venture investor the following [7]:

- Trust - venture investor ensures counteragents confidence: banks and other institutions, suppliers, customers, etc.;

- Council - recommendation concerning the strategy and development;
- The challenge - is opposition to the status quo, constant striving for the better;
- Contacts - additional contacts with key counteragents.

The preceding information is valid, but not always, due to the fact that venture capitalists can be divided into alternate polarity categories: active and passive.

Passive venture investor receives from companies reports annually or semi-annually, may be entitled to "standby" director and rarely come into contact with invested companies [2]. This is a great option for companies that do not want anybody to interfere in their affairs. However, the degree of involvement of venture investor in the work of company does not determine the wishes of the company, and the investor's position. The principle of passive participation is more often associated with companies in later stages of development. But this is not a dogma, as even in the later stages of inattention to the venture investor invested companies can lead to serious consequences. To avoid such consequences, passive investor, though much less often than active, will receive at least the reports on financial results of the portfolio company. If these results will not suit the investor, it is possible that he will become a passive from active. Generally speaking, in times of recession or bad venture investors seek to play a more active role in the affairs of the company.

However, in some cases, passive approach may be effective. Ultimately, the task of the investor is not the management of the company, but management of private investment. The investment management may allow different approaches. As the practice shows, the passive approach is quite rare. About 6% of portfolio companies in the early stages of development, and 8% of the companies at the stage of expansion, contact with venture capital investors less than once per month. While a significant number of companies doing this weekly [10]. Passive participation is more typical for investment aimed at redemption: in this case, less than once a month, with about one-third of interact venture capital received investment companies .

Active venture investor has quite a deep degree of involvement in the work of the portfolio company. As noted above, a proactive approach is more common. Venture capital has low liquidity. This means that the money invested in venture capitalist portfolio company, usually cannot be removed for quite a long period of time. So, to make a minimal risk and maximal profit, venture investors can only by using a firm that receives the investment. Active investor is a business partner of invested company, someone to whom she could turn for help and advice. Active investors usually are experienced people. Many are familiar with industrial characteristics, some are professional financiers. But most important, that all venture investors have experience in facilitating the development of portfolio companies [9].

The financing portfolio company is complex and not a quick process, as is generally carried out in several stages; each of them has its own peculiarities. When the first money is received, the main task of the portfolio company is achieving results that will satisfy investors and will move on to the next round of funding. Seed funding is characterized by small infusions of capital, which may be friends and family, business angels and venture capitalists, specializing in investments in companies at the earliest stages [5]. This is investing in the idea. The idea, however, must be fantastically good and financial infusions are intended to confirm this. The average size of investment for seed stage-$ 1-3 million, while the venture investor will be able to provide the amount to $5 million, and the need for sizes up to $1 ml can be satisfied with business angels. [5]

It should be noted that for venture investing, at any stage of development the company valuation is an important consideration, because of the value of ideas will depend on financing conditions, that is what amount, in exchange for what share of the company will be provided. The first round of financing is usually required to start the commercialization of the product. Up to this point, the company should reduce the uncertainty inherent in the previous round of financing to a minimum. In other words, it must be created by an experienced or commercial product sample, which should be well received by the consumer. Evidence of a positive assessment can be: treaties on sale „brought" product or agreement of confirmation of this intention. When addressing to the venture investor, the company should have a developed business plan and a clear vision of development and a possible exit route. The size of the investment at this stage varies considerably, but is within $2-20 million, in

exchange for 20-40% of the company. Unlike the previous one, is possible at this stage to the formal procedure for assessing the value of the company. [5]

Distribution of shares depends on its value post-investment. For example, if before of receiving of investment, the company was estimated at $4 million and the venture investor provides $2 ml, in exchange he gets 33.3% of shares, calculated by dividing the $2 million allocated to them on post investment value of the company $6 million.

But it should be noted that there is an alternative to funding rounds - financing using the „benchmarks". In this case, the venture investor in advance stipulates the implementation of additional funding in the future to achieve certain results, a portfolio company of the so-called „benchmarks". In some circumstances, effectively turns this method, other-traditional rounds of financing [5].

The second and subsequent rounds of funding are typical for companies who have their own ideas and commercialized as technology development, familiarize yourself with the production, marketing and sales, i.e. closely approached to a stage extension. Additional funding for these companies is necessary for even more powerful development. The volume of attracted capital is typically in the range from $5 million to $50 million and costs are usually only 10-25% of the company.

Subsequent rounds are characterized by the presence of portfolio company leading position, i.e. the main investor shares of the company and several co-investors. At this point, there is the next trend: the higher the risk is, the higher should be return on investment – it is a fundamental rule of venture capital, and any other investment. For example, for seed stage portfolio company receives $3 million for 30% of the shares, as a result of the first round-$20 million for the same 30% and, lastly, in the second round, which is already a preamble to the exit, $30 million for just 20%.

Besides of using the subsequent rounds of financing, portfolio companies may attract so-called transitional funding. The transitional financing – „financing in the form of a type of short-or medium-term lending companies intending to first register their shares on the stock exchange" [2].

However, the transitional financing may precede the next round of funding. The investors who specialize in this type of financing, prefer „simultaneously with the granting of investment in the form of a loan, obtain, so-called „carrot" – an option to buy part of the shares of the company when it is converted into a public" [2]. Transitional funding is more expensive than a bank loan because it is granted without collateral. As the name implies, the transitional funding is necessary for the implementation of a certain transition, for example, move to the next stage of development or transformation of the company from the private to the public. In the second case, the completion of this conversion, which is the initial public offering (IPO), would be to venture investor a release - successful completion of post investment phase.

Gradual transition from one to another round of funding, ending with a successful output of one or more venture capital investors from the company is ideal, but not the only possible leakage of post investment phase.

Some companies are facing with such unpleasant phenomena as decreasing rounds. Decreasing rounds take place when over time the cost of portfolio company does not increases, but decreases. This may be due to the inefficient work of the company and adverse external circumstances, such as when the public markets are experiencing a rapid decline. As a result, diminished the value of the investor's company, which will participate in future rounds of funding, will pay for the shares less than investors who had invested their money in a time when the company's value was higher. As a result, a significant dilution of capital can occur - a devastating event, as for previous investors and for entrepreneur.

Therefore, to protect the early investors, there are a number of tools to avoid press dilution of capital. Not stopping at these instruments, we will note the following details. Historically, the most popular method is a „weighted average" (the prices are weighted per share of the present and previous funding round) that avoids dilution of capital, and is only effective for small financial investments.

It should be noted that venture capitalists seek to have prior rights upon liquidation, often with a very high multiplier. But such a measure could endanger himself return on investment. Evaluation of the effectiveness of the portfolio company is based on the following instruments: IRR and equity multiplier. The multiplication coefficient characterizes the capital repayment of capital in absolute

terms. For example: an investor has invested $2 million, two years later, he returned a $10 million, in other words the project IRR will be 400% and capital multiplier is 5. It must to be note that the IRR is calculated from the date of implementation of investment until the exit of venture investor out of company. Using these indicators at the same time, it is possible to determine the effectiveness of investments [5].

So, a high rate of capital appreciation and low IRR will mean a long period of recoupment of the project, and long term repayment of funds, and, conversely, a high IRR in combination with low capital appreciation is low in absolute terms, repayment of capital in a short period of time. On the one hand, talking about the effectiveness of a venture fund, primarily have in mind internal rates of return, on the other hand, the fund has commitments to the private investors who require return physically tangible assets. So for venture investor is undesirable as an early exit from the company in order to maximize the IRR and excessive delay, aimed at increasing physical refund. A reasonable balance is required.

Comparison with other – is another way to estimate the effectiveness. The comparison methods may be different, and often there are elements of subjectivity. Benchmarking is called objective comparison method. Comparing between the portfolio companies and venture funds, must adhere to certain rules.

Firstly, the companies must work in one sector of the economy. For example, it is incorrect to compare funds, if one invests are in buyouts, and another in the company early on. Secondly, to compare the portfolio companies or venture funds, must to take into account the time needed for obtaining investment or inception respectively. So, venture funds typically invest 3-5 years from the moment of creation and return on investment usually begins at the 4-th year. So, comparing the fund at the age of 2 years, with the fund at the age of 4 years – is completely incorrectly. This is equally true for companies, especially given the pace at which they develop after receiving investment. The assessment of effectiveness and comparison with other companies is built on information. However, the information is required to venture investor, not only to calculate the portfolio company performance indicators, as for decision-making and management investment. On post investment stage, company should approach to data collection and analysis, is no less seriously than venture investor in the process of „thorough examination" [6].

Therefore, the minimum requirement of venture investor is to provide standardized information: accounting reports, cash flow projections and annual budgets. In the case of financing of portfolio company in several rounds, the quality of financial information, in attracting new investors, can play a decisive role, and this is another reason to look carefully on issues of collection, reflection and audit of financial data.

In the part of the non-financial information related to the work of the portfolio company, there are some problems. Firstly, the information it is difficult to formalize, secondly, problematic objectively. Perhaps, the only opportunity for venture investors to receive necessary and truthful information, this is interpersonal contact with company management [2].

Thus, venture capitalists want to trust those who are funding. For entrepreneur – is important to be aware of the plans of venture investor, especially if these plans are linked to the output or the next round of funding. The higher the level of trust is between the management, the more interaction management and portfolio companies have. Professional management-it is the slogan of venture investors, on the one hand, is confirmed by the data of the EVCA rising expenditure on staff development, on the other is a rare post investment stage without replacing the founder. [10]

On this issue there are two polar perspectives. Some managers can be without replacing founder; furthermore, they carry out investments themselves not so much in the project idea, but rather a team of managers, which is handling the project. In their view, a good team can perform the average project, and bad one – can ruin the most promising idea. Other managers believe that the replacement of the company's founder is inevitable, that for each stage of development requires the manager having the appropriate skills . Probably both points of view have a right for existence, since, in practice, have proved their viability. Recommendations of one or another way, as usually, will be based on the details. In first approximation it can be noted that when portfolio company go not so good, it paves the

way for the replacement of the head, and that some of the founders, especially with appropriate education, able to grow along with the company, but others will forced to give way to a professional.

Most of the funds involved in attracting additional funding for subsequent stages of development companies, they invite managers, including top managers, which help them in developing a strategy.

Improved management involves setting management accounting, information technology and international accounting standards. Thus, the ratio of financial and non-financial support to innovative enterprises, by venture funds, meets the needs of companies at different stages of development, thereby significantly increase the effectiveness of the functioning of small innovative enterprises, which confirms how comparing enterprises attracted venture capital, with similar, but not using the funds of venture capital and direct investment and analysis of changes of the basic performance indicators funds funded companies: revenue, profit, number of staff.

Venture capital funds are becoming an important support for entrepreneurs by helping them to find partners, suppliers and customers, as well as strategic managers and professionals. The main investment of a venture capital fund shall not be made in machinery or products, but in people who promote the project in the company's management. A statistical study shows that 67 percent of investors regard as a priority, which the management team must be able to carry out a sustained effort; 67% of investors have valued as a priority the market knowledge of the management team; 31% of investors consider that at the first place there are the abilities of entrepreneur's leadership and, somewhat surprisingly, only 28% considered that the main success factor is from investment earnings. [4]

In the European Union, risk capital is regulated only at Community level by Regulation No 17. 345/2013 of 17 April 2013, regarding European funds for venture capital. In other countries, like Russia, Belarus, Georgia, this activity is regulated under other laws, and in Armenia there is a separate law on risk capital. It is important to note that in the European Union there are 26 venture capital funds, half of them being in the United Kingdom.

In Moldova, there is no legal framework for business angels and venture capital. The need to create a legal framework was presented through a concept of law on risk capital, to working group meeting at the Economy Ministry in July 2015. [7]

It based on:

- ".
- The development strategy of small and medium-sized enterprise sector for the 2015-2017 years;
- The National Action Plan for the implementation of the association agreement with the European Union;

The Innovation Strategy of the Republic of Moldova for the period 2013-2020 „Innovations for competitivenessThe authors of the project were determined that the primary purpose of future laws consists of the stimulation of enterprises, in particular innovative SMEs with growth potential by opening access to venture capital funds. In this context, risk capital is viewed as an efficient source of funding and technology transfer, but SMEs are the main beneficiaries of this form of investment.

The main components of the draft law have regulations regarding the activity of venture capital funds, the conditions of creation, approval, and operation of these funds, for the monitoring of their activity, portfolio requirements investment, investment techniques and eligible businesses that apply to a venture capital fund.

If it will be successfully created the legal framework, then local professional investors such as banks, insurance companies, pension funds, etc., will be able to invest the financial resources of over 100 thousand euros in the form of risk capital through capital funds risk in the shares or quotas for the participation of SMEs. At the same time it will create conditions for entry on the capital market of venture capital funds.

Conclusions

The attraction of foreign investments in the Republic of Moldova shall continue to be a strategic action for the State. The importance of identifying new sources of financing, in this case the

business angels and venture capital, and creating a legal framework in order to bring them into the country, may greatly improve access to financing for SMEs, with new financial instruments and new opportunities for the development of innovative projects, the increase in the volume of exports, the reduction of the level of unemployment, improving the quality of life, etc.

To achieve this objective it is necessary to develop the skills of local entrepreneurs with the aim of creating long-term strategies to attract funding at every stage of life. In addition, it is necessary to provide assistance to SMEs for the professional implementation of the bootstrapping method, which is very necessary at the start-up stage.

At the same time, the process of creating the legal framework in the Republic of Moldova for the activity of venture capital funds should be continued in a limited time. Major attention should be drawn to the creation of the legal framework for the activity of business angels, because these investors are the transition from start-up stage - bootstrapping to the extension - venture capital, providing shifting to growth stage - institutional investors.

REFERENCES

1. A Guide To Private Equity, EVCA, October 2004. p. 45.
2. Bejamin and J. Margulis, The Angel Investor,s Handbook: How to Profit from Early-Stage Investing, Princeton: Bloomberg Press, 2001;
3. Conceptul pentru discuţii „Legea privind capitalul de risc", Ministerul Economie, 27 iulie 2015;
4. Community development venture capital alliance, http://cdvca.org /;
5. Catherine, Campbell. Venture business: new approaches, translation from English / Katherine Campbell. - M.: Alpina Business Books, 2004. - 337 p.Толковый словарь терминов венчурного инвестирования. – СПб. : Феникс», 2006.
6. Canada One magazine. Equity Financing: Understanding Venture Capital, by Julie King. 2010. www.canadaone.com/ezine Five Ways To Ruin Your «B Round» While Doing Your «A Round», by Scott A. Perricelli, Edward M.
7. Dionisie Comerzan, Finanţarea nebancară a întreprinderilor mici şi mijlocii prin intermediul business angels şi a capitalului de risc, 1.12. 2015, accesibul on-line: https://edufin.md/finantarea-nebancara-a-intreprinderilor-mici-si-mijlocii-prin-intermediul-business-angels-si-a-capitalului-de-risc/
8. European approach to direct and venture investments. RAVI. - St. Petersburg. : Phoenix, 2009. - 103 p
9. Kotler, H.Kartajaya, Atracting investors, A marketing approach to finding funds for your business, John Wilez & Sons , Inc, 2004;
10. Survey of the Economic and Social Impact of Venture Capital in Europe, Research Paper, EVCA, June 2002.
11. Survey of the Economic and Social Impact of Management Buyouts & Buyins in Europe, Centre for Management Buy-out Research (CMBOR) for EVCA, January 2001.
12. V.Vagizova. Venture capital management in the modern innovative business: opportunities and prospects. National interests: priorities and security. 36 (177) - 2012. LLC Publishing House FINANCE AND CREDIT, Moscow. ISSN: 2073-2872
13. http://www.eesc.europa.eu/en/policies/policy-areas/enterprise/database-self-and-co-regulation-initiatives/75

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MODERNIZATION AS THE KEY ELEMENT OF INNOVATIVE PROGRESS AND ITS IMPACT ON THE SOCIO-ECONOMIC DEVELOPMENT

PEPA TARAS, PhD
Professor, Department of Management and Public Service,
Chernihiv National University of Technology,
e-mail: tarrasp@gmail.com

Abstract: *The article presents modernizational changes as the driver for innovative development which is characteristic of the modern trend of transition to the new level of technological and social development marked by the knowledge-based economy and network society. Explained is the intrinsic characteristic of modernization which is to help alleviate negative side-effects normally associated with drastic and rapid changes in the course of technological revolutions.*

Social impact of the modernizational advance along with the social modernization phenomenon are examined with recognition that their produce direct and most serious influence on the lifestyle and wellbeing of the people. Furthermore, efficient modernizational strategies, which should result in the most effective synergetic outcome of the transformational progress, are reviewed along with the key modernizational goals explained and substantiated.

Proceeding from the fundamental paradigm that innovation lies at the heart of all current modernizational processes, the parametrical analysis and evaluation of the modernizational potential is presented as one of the principal elements in the process of developing national innovation strategies.

Key words: *modernization, innovation, science and technology revolution, modernizational potential, social impact, social modernization, factors, socio-economic development, transformations, knowledge economy, network society.*

JEL: O30, O33, O44
UDC:334.012.2

Introduction

Nowadays modernizational changes and reforms often prove to be akin to significant technological transformations and sometimes even technological revolutions of various forms which are currently progressing in our life and result in creating new approaches toward economic development, give rise to new products and industries, crucially transform industrial and employment structures and thus modify the very focus of the world economy shifting it from mere profit making to data and knowledge accumulation.

As the leading industry of the world economy has changed to knowledge we can observe the gradual emergence of the network society and ultimately the network-based personality which is a sort of online image of natural person who obtains needed knowledge and information through the network sharing activities. Obviously, this impacts significantly the social environment that people live in, with one of the key changes being the fact that the ability to find necessary information and knowledge is becoming to prevail over the traditional possession or memorizing of such respective information and knowledge. This observation demonstrates yet another important influence of the modern network society on individual characteristics and behaviour and ultimately on the modern socio-economic system as a whole.

Analysis of recent studies

The scientific-technical revolutions which force modernizational-transformational changes in the economic systems serve as basis for the national advancement while presenting new strategic opportunities, and countries exploiting such opportunities are able to achieve the world's advanced level of development while those ignoring such usually enjoy poor performance and even suffer from the decline in international status. According to many experts' prognosis, the next upcoming revolution will be producing much greater impact, both in economic and social terms, than the previous ones as it will this time present the combination of scientific, technological and industrial upheavals: it will be a revolution of new biology from the scientific perspective, revolution of bio-creation and bio-regeneration from the technological perspective, revolution of bionics from the industrial perspective,

and also revolution of bio-regeneration and long life from the perspective of civilizational development. Thus, it is true to say that the next scientific-technical revolution will profoundly change our views of life and lifestyle, learning, work, family relationship and life expectancy in a very radical manner while granting the people a sense of liberation through super green manufacturing system and artificial intelligence expected to be used extensively to replace people's manual and mental labour.

In an attempt to formalize the above ideas and streamline the process of adjusting our life and activities to the profound changes ahead the modernization study has emerged as a new interdisciplinary science which includes the modernization theory and knowledge, and deals with modernization phenomenon by explaining both the crucial changes in the modern civilization and the principles of national advancement along with the international competition and differentiation. Being a new discipline of science it effectively embraces three key meanings: knowledge system on the facts, features and principles of the modernization; scientific research on the modernizational phenomenon; and rational thinking and methods to carry out modernizational research.

The purpose of the article

The general modernizational activities can be described as actions aimed primarily at realizing profound transformations and reconstruction on the basis of entirely new and innovative progressive principles of the economic structure, organization and management in response to the modern challenges and trends. It is targeted to make progressive improvements to the object of an economic system as well as support its steady advancement and development, and therefore it becomes an integral part of the innovative activities. Innovative products developed and produced as a result of modernizational activities possess a completely and entirely new character since they are obtained not just on the basis of a simple new knowledge application but rather on the more comprehensive principles of the novel knowledge-based economy. Indeed, modernizational activities produce transformations, progressive changes, structural shifts, and promote re-invigoration of the economic system on the basis of expedited investment-innovative activities.

Modernization also means achieving new progressive form by an economic system: in technological sphere this leads to a higher technological development stage, in social sphere - to post-industrial and network society, and in cognitive area - to informational society. Modernization is also becoming crucial for achieving higher levels of competitiveness and socio-economic system development, as it brings positive transformations focused on increased efficiency through innovation and innovative management techniques, and impels reformation in response to the inefficiencies arising within the existing management system with the purpose of stabilizing functional parameters of the socio-economic system. Thus, modernization can, in a way, be described as the ability of modern people to scientifically direct progressive changes in the society in order to effect improvements needed to successfully respond and react to the challenges of modernity through efficient structural, technological, and institutional changes in the national economy aimed at enhancing its competitiveness and ensuring its long-term sustainable development. Modernization is therefore enjoying a dual nature by being, on one hand, a *comprehensive process* comprising changes implemented in economic, political, legal, and cultural institutions and relationships and performed at several levels at the same time, and, on the other hand, a *mobilization process* introduced to narrow the lag with competitors.

The ultimate result of the successful modernization should be the establishment of socially responsible economy which is dynamic and capable of self-improvement, can comprehensively involve general public into efficient labour with proper motivation, ensures effective utilization of all available production resources of the society, capable of realizing intellectual potential of a country through science and education development, and is effectively based on modern social relationships. Achieving this is possible, first of all, through successful transition toward the network structure of activities and management which proves optimal in conditions of unstable interaction between various involved organizations, and presents an adaptive model of a complex social and economic system which includes respective discrete processes, projects, and programs.

With the purpose of this article to, firstly, emphasize the significance of modernization for efficient development of an economic system, and, secondly, analyze the impact of respective transformational changes and shifts on the social sphere, it is important to stress that the science-technical revolutions, and modernization as its key component, always provide new ideas, new life conditions and new knowledge for social progress such as scientific spirit, methodology and knowledge. Therefore, people's lifestyle has been marked successively by the use of machinery, electricity, automation and informatization, while people themselves have experienced the progressive change of life from a rural to an urban and then international one, from real to virtual one. Nowadays, social, economic and educational spheres become closely integrated by the phenomenon of intellectual resources as the most dynamic factor of modern society development with social, economic and educational projections becoming the key components of human life and society. As the beginning of the 21st century saw a transition from industrial to innovative type of economy based on the priority of new knowledge and production of the new type of information, it became quite obvious that modernization should regard education as one of its focus spheres. The key point of modernization in education lies in transformation of the educational system in order to ensure its steady development on the basis of advancing innovative scientific findings, therefore basic studies in the field of methodology of education should be focused on defining and substantiating the common set of strategies which can be integrated into the mechanism of modernization and theoretical background for development of innovative teaching and training techniques.

With the development of the post-industrial economy and knowledge-intensive industries specializing in high-tech products, modern processes of development of the global economic system are increasingly characterized by the emergence of a new paradigm, according to which the nature, main trends, pace of development of the post-industrial innovation-driven global economy are increasingly influenced by the development and accumulation of scientific knowledge, intellectual potential of the society, knowledge and science-intensive labor processes. Thus, the highest priority goes to the development of a new knowledge that can ensure social and economic progress, and the mechanisms of such knowledge production should include fundamental and applied sciences, system of communications, educational establishments, system of patents, etc. In this context, the contribution made by well-established educational systems will effectively define the level of knowledge obtained and spur creation of new technologies. So, against the background of technological rise which is becoming crucial for the economic growth of the state, when the knowledge and information turn to main productive resources, the formation of *intellectual potential* capable to generate new knowledge becomes one of the main tasks to achieve.

The development and modernization of the educational system, and then innovative research capabilities, is thus growing into a critical factor for the formation of a knowledge society as it practically becomes a determinant of the technological rise and characterizes the very economic growth of the state ultimately resulting in the increased national competitiveness on the international stage. As the steady social and economic development of the country is closely connected with the efficient development of education, training and innovative research, the economic growth becomes also largely associated with the increased investments into an individual personality, including through the quality of educational system, as a defining factor for the formation of the society of knowledge.

With proper recognition of the importance of efficient education and training for preparing highly skilled workforce as one of the key social impacts of the transformational-modernizational changes in the economic system it is also important to review in a greater detail the very essence of the general socio-economic influence of the modernizational advance. First of all, it should be observed that socio-economic impact is different from the social-economic impact, as these must be two substantially different categories, and their difference, though seemingly insignificant at first, should be clarified. So, the social-economic transformation could be interpreted as a simple combination of social and economic factors producing positive effect by adding one parameter to the other. As an example, social-economic impact may be reached by opening a new department at a local hospital which enhances medical care in the area by offering improved health services to the community as well as provides new workplaces for the members of such community. On the other hand, the socio-economic impact is characterized by an effect of synergy or rather such specific interaction between

the components that can produce dramatically new results in both economic and social sphere. For instance, this could be the modernization of the public transport system with self-driving modules replacing bus drivers with robotized driving devices with the purpose of increasing driving safety, efficient driving schedule monitoring, dispensing with potential human error, etc. Evidently, this kind of modernizational impact is capable to produce quite far-reaching repercussions of both positive and negative character, therefore it is the socio-economic transformations that should be specifically identified, monitored, evaluated and strategized into any plan of modernization to ensure that their ultimate synergetic effect brings positive results.

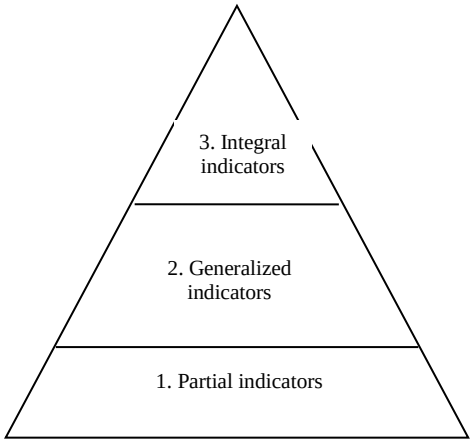
By claiming here that modernization constitutes and integral component, or rather an instrument, of the science and technological revolutions, and also duly recognizing the common fact that technological revolutions almost always together with the scientific breakthroughs and great discoveries bring along serious destruction of old and traditional parameters, it is important to recognize that one of the key essences of modernization should be the *alleviating factor* of any possible destructive elements arising from revolutionary changes in the scientific area which can accordingly produce quite negative impact on the society. In other words, modernization must provide for orderly innovative transformations and shifts as compared to revolutions with their breakneck pace of changes and sweeping radical effects which may not be always accurately predicted and therefore orderly manipulated. In a way, modernization is an instrument to harness rapid innovative advance and radical transformations so as to most efficiently adapt them to the primary purpose of enhancing the socially responsible economic development with all necessary attributes of sustainable growth and prosperity.

The new type of the economy which is based on the knowledge bears evident difference from the earlier agrarian and industrial economies in that, although natural and material resources continue to serve as a basis for creating economic wealth, it provides a greater degree of internal, nonmaterial factors, the most important of which are the knowledge and human capital. Thus, very important aspects of the knowledge-based economy will always include sustainability and social responsibility as the instruments of channeling modernizational transformations for the benefit of people's wellbeing, and as such the knowledge-based economies will have the following conspicuous manifestations:

- major role would go to production of services, information and cultural products;
- industries not based on the physical infrastructure will take the leading positions;
- improvement of older yet still viable infrastructures with their gradual renewal will be progressing;
- continuous growth in scientific research financed by both the state and business will rise and expand;
- stable capitalization growth of innovative companies will be observed;
- emergence of individual with creative thinking as the key element of the national wealth will occur;
- priority investments will go into individual fundamental knowledge;
- research and educational centers will grow into clusters of production and development activities.

As the world countries realize all the benefits that transition to the knowledge-based economy brings they develop individual strategies and measures to promote this process. These are normally tailored to best respond and adapt to the specific features and peculiarities of both economic systems and social environment of a country. Another important factor here is also the ability to properly evaluate and analyze the modernizational potential that each country has, which becomes increasingly essential in order to be able to use it as one of the key criterions in the process of developing efficient modernizational strategies. One of the effective techniques for evaluation of the modernizational potential can be the parametrical analysis performed at several levels/stages providing a comprehensive picture of all available components which should be efficiently exploited in the future.

The following graph presents panels (stages) of parametrical indicators of the modernizational potential analysis:



where:

(1) represents indicators reflecting the component structure of the modernizational potential;
(2) represents indicators which characterize the level of development of main components of modernization and their intrinsic factors;
(3) represents indicators of parameters of the potential which reflect integration of all functional elements of the system.

As regards the concrete steps in Ukraine aimed at promoting modernizational advance the following modernizational efforts as of late can be named:

- *from the institutional perspective*: the government has for the first time allocated finances (50 million UAH) in the budget for the development of innovative ideas and products. The money will be channeled to the newly established Innovation Fund which will distribute it to the most successful and prospective innovative projects. Furthermore, the one-year postponement of the tax payment was proposed by the government for the import of modernizational products and services into Ukraine;
- *from the business perspective*: the European Investment Bank had approved the loan (about 40 million Euros), the first of its kind for Ukraine, for modernizational activities in the agricultural sphere, namely storage facilities improvement, allowing the company receiving this loan to develop innovative software to control and monitor operation of respective storage equipment.

These are just some measures and steps in the process of development of the Ukrainian economy with the focus on modernizational aspect, and obviously they demonstrate both the recognition and importance of the modernizational-transformational changes for the sake of efficient economic development in the country. Also, many other countries have already recognized the importance of modernization and even proclaimed the rapid transition to the knowledge-based economy as the national strategies aiming to, first of all, reduce their dependence on foreign technologies and products. In general, the measures undertaken in various countries to achieve this task can be narrowed down to the following:

- increased funding for educational and training system;
- recognizing education and knowledge as key priorities of the development;
- creating favourable conditions for the transnational corporations to open their production and research facilities on the ground;
- creating technological parks and clusters as the areas of promoting the development of high and new technologies;
- providing scholarships for local talented students to study abroad in the world class educational institutions;
- increasing support to theoretical research associated with the knowledge economy.

In some cases such measures are added with the efforts to re-invite scholars and scientist who had left the country earlier and achieved significant progress abroad to return to the home country and

apply their gained knowledge and skills there. Moreover, modernizational efforts may often include focusing on the development of the strong national services sector as well as concentration of the most official support on specific key and priority technological areas and industries which should serve as so called "locomotives" of the innovative development.

With the review of a whole spectrum of modernizational efforts ranging significantly in their essence and scale it is absolutely clear that modernization of the economy with the purpose of increasing wellbeing of the people becomes an indispensable element of the modern globalized development. The most evident social impact of the economic modernization, therefore, can be observed through social transformations and shifts which are often presented as the *social modernization* activities. As a part of greater general modernizational concept, the social modernization can be interpreted simply as the modernization of the social sphere in the form of a social change and international competition since the latest industrial revolution. It is also often called the frontier process of the formation, development, transformation, and international interaction of the modern society; a comprehensive process of the innovation, selection, diffusion, and elimination of social factors; and also the international social competition, differentiation, and stratification to catch up with, reach, and maintain the world's advanced level of the social development. Progressing in the transition from agricultural to industrial society and from industrial to knowledge society, social modernization brings the improvement of social effectiveness and quality of life, significantly changes lifestyle and living ideas, and enhances civic quality of culture and health, social welfare, equity, and international social status.

Social modernization thus means the world frontiers of social change and the process to reach such frontiers, so the initial social modernization as a transition from agricultural to industrial society and from family to welfare society was focused on urbanization, welfarism, mobility, specialization, rationalization, electrification, technologization, equity, social differentiation and integration, universal primary education, etc. It resulted in the formation of the first social modernity and diversity, while its major side effects included the widening gap between the rich and the poor. The next social modernization which is currently underway is pursuing a transition from industrial to knowledge society and from material to ecological society. Its main features include: intellectualization, informatization, suburbanization, urban–rural balance, green development, ecologization, naturalization, innovation, internationalization, diversification, individualization, leisure, rights of women and children, universal higher education, lifetime learning, and so on. While its ultimate result should be formation of the second social modernity and diversity, the very negative impact it brings is the serious information divide. Generally, the integrated social modernization is presented as a basic path for the world developing countries in the twenty-first century.

Based on the above, the following functional mechanism of the social modernization can be summarized (Fig. 1):

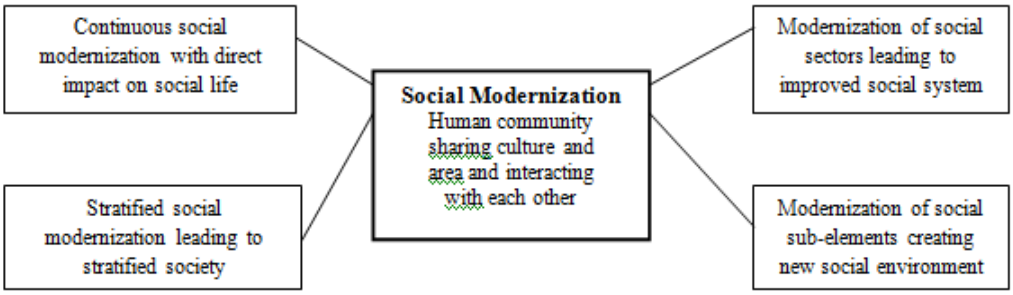


Figure 1. Social modernization operational-functional mechanism.

Recognizing importance of the social impact of modernization it should be stressed that modernizational transformations comprehensively progress in all three domains of the societal development, namely economic, political and social-cultural, though its specific extent is not necessarily uniform in all of them. Economic modernization primarily refers to a change of perception concerning earning profit, rational economic activity, widespread use of sophisticated technology and

dedicated effort to bring about innovative changes in the production system. In this context, industrial and post-industrial economies foster people with the entrepreneurial drive and strong profit motive as well as rational and scientific views towards economic enterprise who also make an excessive use of sophisticated modern technology, while extensive modernization activities lead to the increase in consumerism when people become more interested in excessive purchases and develop the habit of consuming more and more while changing the items quite frequently. The successful political modernization, in its turn, should result in a satisfied public and politically modern society with very vibrant civil society capable to effectively protect the rights of fellow citizens. Modernization as a process of cultural change produces rational and scientific world views and new social values on the basis of which progressive changes in the social system take place.

Although for the sake of theoretical analysis it is possible to break down modernization process into categories of economic, political and social-cultural transformations, it has to be reiterated that modernization presents an integrated, complex and comprehensive process which impacts all three domains although in a different extent and scope. Thus, it is very important to make sure that the modernizational strategy developed in the country provides for efficient balance between all these three major components of the modernizational transformations so that they produce synergetic effect rather than present a mere combination of efforts and measures. Being at the core of the economic development strategies modernization requires that such strategies be based on the principles of innovation which will ensure reforming of all branches of the economy, establishment of new and more efficient economic structures with relevant protection mechanisms against globalizational challenges as well as promote rapid and efficient development and advancement. Obviously, in this context the very ability to create innovations will for long remain one of the key factors determining the place and role of a country on the world stage, its competitive advantage, and ultimately will determine its capacity to modernize national economy and ensure continuous production of innovative products. It can thus be inferred that the core of the modernization is formed of innovative technologies and related economic and social institutions with modern globalization processes playing a significant role of a very strong catalyst in the progress of modernizational transformations.

As the innovation is regarded crucial for the economic advancement in the globalized world, modernization of the economic system becomes an instrument for implementation of innovations, with success in the modernizational advancement guaranteeing successful innovative progress of the economic system as a whole. To achieve successful generation of innovations a comprehensive approach should be taken toward effecting necessary changes and improvements in the following three major areas: institutional reforms - improving rules and procedures of the social and economic life; organizational mechanism and economic policy - application of relevant and effective instruments of influence on economic processes; and social policy - enabling all social groups to realize their interests in the most effective way. Generally, the concept of the innovative development determines priority directions of the state policy which should start with the establishment of relevant institutions to support financial, scientific and industrial entities in introducing and implementing innovative ideas and products. For this purpose initially adequate fiscal measures and steps should be taken, namely: reduction of taxes, provision of tax credits, expedited amortization, targeted support through grants and loans combined with the formation of adequate infrastructure of the innovative economy, advance development of the humanitarian sphere, introduction and development of general innovative culture.

The successful implementation of the above priorities should result in a highly efficient and socially responsible modernized economy capable of the dynamic self-improvement, effective involvement of the general public into modernizational efforts, efficient use of all available production resources, primarily human ones, and continuously producing favourable conditions for successful realization of intellectual potential of the country, through science and education, under complex modern social relationships.

Conclusion

Modernization is crucial for the modern innovative development and can be viewed as an efficient instrument of the science and technology revolutions taking place on the global economic stage.

It brings comprehensive impact on all spheres of human development, with social impact being the most noticeable in terms of ensuring better life and work conditions for the people and ultimately contributing to their wellbeing. Proper assessment of the social impact in the modernizational strategies of the countries should safeguard the population against possible negative side-effects of the rapid technological advance and transformations.

Efficient modernizational efforts should serve not only to advance the socio-economic development of the country but also smooth out the transition to the new technological level of the knowledge-based economy, while effective evaluation of the modernizational potential will provide better understanding of the modernizational effects on the future economic advancement.

Social modernization is the one having the most visible effect on the life of the people and thus should be adequately reflected in the general modernizational strategies with its key focus on improving lifestyle of the population under the circumstances of current significant changes in the system of human relationships.

REFERENCES

1. CHUANQI HE. The scientific and technological revolution and world modernization / Book of China Center for Modernization Research, Chinese Academy of Sciences, Beijing, China. - 2011.
2. GEYETS V. Liberal-democratic base: Course for modernization of Ukraine / Ukrainian Economy. - 2010. - #3.
3. GEYETS V. Innovation prospects in Ukraine / Konstanta, 2006.
4. ONYSHCHENKO V. Modernization as an imperative of the Ukrainian development / Ukrainian Economy. - 2011. - #7.
5. VARDOMSKY L.B. Mutual economic ties in the context of modernization of the Russian and Ukrainian economies / Economy and prognosis. - 2009. - #1.
6. UKRAINE-2015: National development strategy. - Kyiv.: Civil-political association "Ukrainian forum". - 2008.
7. BUZHYMSKA K.O. Modernization of Ukrainian economy under globalization: main trends and problems / Visnyk ZHDTU. - 2008. - #3.
8. KARPOVA N.K., UVAROVSKY A.P., MAREEV V.I., PETROVA N.P., BORZILOV Y.P. Methodological features of educational system modernization in the context of the "Economy of knowledge". International Journal of Environmental and Science Education. - 2016. - Vol.11, No.18.
9. 9.PETERS MA, BESLEY AC. Building knowledge cultures: education and development in the age of knowledge capitalism. Rowman & Littlefield, Lanham, MD. - 2006.
10. INGLEHART R, WELZEL C. Modernization, cultural change, and democracy: the human development sequence. Cambridge University Press, New York. - 2005.
11. RGCMS (Research Group for China Modernization Strategies et al). China modernization report 2010: world modernization outline 1700-2100. Peking University Press, Beijing. - 2010.

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EVALUATION OF EFFECTIVENESS OF INNOVATIVE MODERNIZATION OF FOOD INDUSTRY

KOVALENKO OLGA,
doctor of economic sciences,
senior research worker,
head of the department of economic research,
e-mail: okovalenko0960@gmail.com

VERBYTSKYI SERGII,
candidate of technical sciences,
head of the department of informational support,
standardization and metrology,
e-mail: chaink@ukr.net

LYSENKO HANNA,
Ph. D. student,
junior research worker,
e-mail: lisenko-anja@ukr.net
Food Resources Institute of NAAS of Ukraine
(Kyiv, Ukraine)

Abstract: *The article presents a methodological approach to the evaluation of innovative modernization of food industry and its constituent branches. The innovative modernization of the food industry is proposed to be understood as systematic improvement in all spheres of activity and in the state of the productive potential, the said improvement to be reached through the effective implementation of the results of innovation activity and providing fundamentally new level of production base. The innovation index is proposed as the criterion for assessing innovative modernization of food, this index being a numeric characteristic facilitating comparison of the effectiveness of modernization on an annual basis. It was found that most part of food industry branches feature low degrees of the efficiency of innovative modernization. To achieve strategic innovation development objectives as the basis of formation of agricultural and food policy, such priorities are denoted: lingering political and economic crisis, unstable fiscal and monetary policy, inflation, expansion of foreign producers the domestic markets, etc., these priorities being possible to be implemented only when negative phenomena in national economy would be overcome.*

Keywords*: food industry, innovative development, modernization, innovation index, efficiency.*
JEL: L66, C15, C42, C51
UDC: 338.45(477)

Introduction. The food industry of Ukraine consists of specialized branches, including more than 40 forms of production activity. It provides not only primary processing of crop and livestock raw materials, but also production of food products – from essential goods (meat, dairy, bakery products, sugar, fat and oil, etc.) to delicacies and functional products for health promotion. The share of food sector output to national economy Ukraine was about 10% in 2015. According to its specificity and also taking into account the current needs of consumers, the food industry can supply goods produced both according to traditional and novel knowledge-intensive technologies. Technologies and industries are considered knowledge-intensive when their innovation level is high. Sufficient economic efficiency based on resource-saving and significant share of added value in the products produced, are their key characteristics.

Development of the economy of food industry, its structure being complex and multi-level is stipulated by a number of factors. Now particular attention is paid to the detection and study of innovative factors as they determine the effectiveness of the modernization of food industry economy, and the knowledge becomes the basis for the formation of effective agricultural and regional policy.

Modernization of the economy has been and remains the priority in the programs of economic reform developed by a number of Ukrainian governments. However, the main drawback of these programs is the lack of timely evaluation and clear understanding of measures and resources necessary to fulfill the said reforms.

Analysis of recent research and publications. Development of modernization paradigm dates back to the mid-twentieth century. Some of its provisions are set out in the works of American scientists Daron Acemoğlu and Joan Robinson [1], N. Gilman [2], A. Przeworski, F. Limongi [3], many Russian scientists, including I. Gyliazutdynova [4], V. Sadkov, P. Mashehov, Ye. Zbiniakov [5], S. Dyomin [6], D. Ushakov [7]. This paradigm was reflected in the well-known Marshall Plan.

Theoretical and methodological aspects the modernization of national economy are highlighted in the works of the Ukrainian scientists B. Andrushkiv [8], O. Bilorus [9], K. Buzhymska [10], N. Valinkevych [11], V. Heyets [12], L. Deyneko [14], P. Sabluk [13], M. Sychevskyi [14], A. Chukhna [15], O. Shubravska [16] and other scientists. However, the issues of effectiveness evaluation of modernization of the economy of food industry have not yet been properly studied.

The aim of the article is to develop scientific approach to evaluating the effectiveness of the modernization of food industry and its branches.

Research results. In a broad sense, the modernization is the willingness and ability to develop on the innovative basis, to move from one way of activity to another, more progressive, the ability to build progressive forms of activity on the innovative basis, to create models of these forms according to peculiarities of the national economic environment. In modern conditions innovativeness shall be the characteristic feature of modernization its traits being: innovative flexibility, willingness to change, including the formation of a comprehensive infrastructure for management, forecasting and use of versatile information on industries.

Researchers believe that innovativeness is the ability of objects or phenomena to update themselves, when recovery processes become permanent, technological and minimally costly [4]. The effectiveness of the implementation of modernization measures directly affects the level of economy competitiveness of states and regions, their level of manufacturability, the quality of life in these areas. In this sense, important indicators of the state of modernization of economy are: The Global Competitiveness Report – Global Competitiveness Index (GCI), which is developed according to the methodology of the World Economic Forum (WEF) [17, 18]; The Doing Business Rating; Corruption Index – Transparency International; Index of Economic Freedom – Heritage Foundation etc.

In the works of classical economic theory the use of new technique, new technological processes; organization of production, logistical support; introduction of products with new properties; use of new raw materials, identification of new markets were defined as the evaluation criteria of innovativeness [19].

The determining factor of the modern development of any economic system is an efficient innovation process. So, when it comes to the effectiveness of economy modernization, scientists always look for confirmation of its innovativeness, namely consequences of influence of innovation activity and scientific and technical progress. In this regard, now the notion of innovative modernization has been spreading in the economic science.

We consider that innovative modernization of the food industry should be understood as systemic improvement of all areas of business activity and the state of the production potential to be achieved through the effective implementation of results of innovation activity and providing qualitatively new level of production base.

No clear methodological approaches to assess the degree of efficiency of innovative modernization have been yet proposed. In Ukraine to evaluate the development of innovation processes a system of statistical indicators is used: the number of enterprises implementing innovation (scientific research works, new equipment, technology, organizational and marketing innovation); the volume of innovation production sold, including that new for the market; the number of new technological processes implemented and of innovative kinds of products, acquisition and transfer of new technologies; the volume of expenditure on innovation etc.

According to the defined system of indicators, the results of the assessment of innovative activities in 2015 are: only 178 food industry enterprises of 984 surveyed (18%) showed certain innovation activity, and

no more than 2% of those 178 enterprises performed any kind of research. Innovative activities of a half of innovation active enterprises consisted in acquisition of new machinery, equipment, software and the corresponding spends reached 87.2% of the total amount of costs. However, only 13% of implemented innovative products were new to the market. Overall dynamics of innovation development of food industry demonstrates the come-down of economic situation in accordance to most of indicators (Table 1).

Table 1. Effectiveness of innovation processes in the food industry (authors' development on the basis of State Statistics Service of Ukraine)

Indicator	Year				The increase (decline) 2015 to 2012, %
	2012	2013	2014	2015	
Number of innovation active economic entities, units	420	324	334	178	*-57.6*
The share of the total number of economic entities investigated, %	*18.7*	*17.1*	*16.8*	*18,1*	*-0.6*
Total expenditure on innovation activity in the food industry, million UAH	1566.3	1700.7	2173.61	1143.3	*-27.0*
The share of expenditure on purchase of machinery, equipment and software, %	*78.9*	*88.1*	*86.2*	*87.2*	*8.3*
Volume of sold innovative products in the food industry, million UAH	4612	7275	6290	4874,5	*5.7*
The share in total volume of food industry products sold, %	*1.8*	*2.8*	*2.5*	*1.3*	*-0.5*
including new for market, %	*0.6*	*0.7*	*0.2*	*0.2*	*-0.4*

Source: State Statistics Service of Ukraine

The system of existing statistical indicators to assess the status and dynamics of innovation processes (Table 1) does not give a fair idea of the final results of food industry innovative modernization.

In macroeconomic studies the indicator of gross value added (GVA) is applied to show the effectiveness of economic development. In particular, if GVA growth rate outpaced the cost growth rate in the industry, then it is considered, that the economy is developing effectively. Applying this methodological approach to assess the effectiveness of food industry's innovative modernization the growth rate of gross value added and total costs are calculated by the formula:

$$GR_{GVA} = (GVA_t / GVA_{t-1} \times 100)-100, \quad (1)$$

$$GR_C = (C_t / C_{t-1} \times 100)-100, \quad (2)$$

where

GR_{GVA} і GR_C – the growth rate of gross value added and total costs in the food industry, %;

GVA_t і GVA_{t-1} – the gross value added of food industry in the time periods *t* та *t-1* respectively, million UAH;

C_t і C_{t-1} – the total costs in food industry in the time periods *t* та *t-1* respectively, million UAH.

The calculation results are presented in Table 2.

Indexes of increase (or lag) of GVA growth rate compared to cost growth rate show that in 2014 the industry began to develop effectively (Table 2). However, the indexes are not consistent with dynamics of innovative activity of food industry (Table. 1) and do not characterize the degree of effectiveness of its innovative modernization in each year of the time period studied. To remedy this shortcoming, we propose to define a criterion for assessing innovative modernization of the food

industry – an index of innovativeness. The gross domestic product (GDP) of food industry and the total costs of the industry, calculated in USD to avoid inflation factor are chosen as input data for its calculation. The selected input parameters of the study show a downward trend during the years 2010-2014 (Fig. 1).

Table 2. Calculation of indicators of efficiency of innovative modernization of the food industry (authors' development on the basis of State Statistics Service of Ukraine)

Year	Gross value added of food industry			Costs in food industry			Index of increase (lag) GVA growth rate over the cost growth rate, %
	million UAH	absolute growth (ΔGVA), million UAH	the growth rate GVA, %	million UAH	absolute growth (ΔC), million UAH	the growth rate of intermediate consumption, %	
2010	45459	–	–	151956.0	–	–	–
2011	44134	-1325.0	-2.91	176548.0	24592.00	16.18	-19.10
2012	46904	2770.0	6.28	220388.0	43840.00	24.83	-18.56
2013	46070	-834.0	-1.78	221416.0	1028.00	0.47	-2.24
2014	56979	10909.0	23.68	248405.0	26989.00	12.19	11.49

Source: State Statistics Service of Ukraine

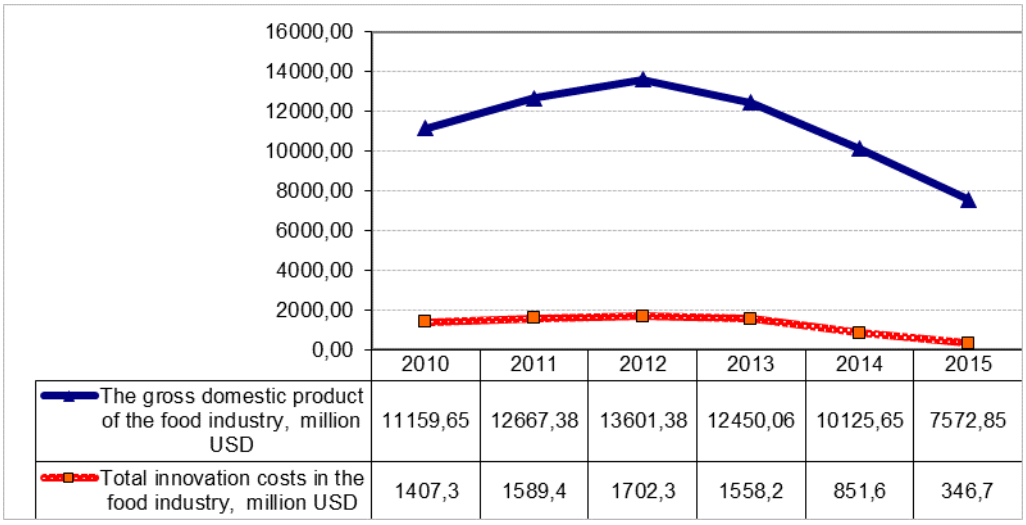

Figure 1. Input data for the calculation of the index of efficiency of innovative modernization of food industry (authors' development on the basis of State Statistics Service of Ukraine)

The index of innovativeness of the economic activity of food industry is characterized by growth rates of its resource intensity in certain periods of time:

$$I_{in} = \frac{r_t}{r_{t-1}}, \quad (3)$$

where I_{in} – index of innovativeness of the economy of food industries; r_{t-1} і r_t – resource intensity: the amount of costs per unit of GDP in the time periods *t* та *t-1*:

$$r_t = \frac{C_t}{GDP_t}, \quad r_{t-1} = \frac{C_{t-1}}{GDP_{t-1}}, \quad (4, 5)$$

where

GDP_t і GDP_{t-1} – gross domestic product of the food industry in the time periods *t* та *t-1* respectively, USD;
C_t і C_{t-1} – the total costs of innovative activities in food industry, USD.

Innovativeness of the technologies applied is defined by the fact that their application not only provides saving of production resources, but also increases production output. If the innovativeness relative index value (resource intensities ratio) converges to 1, then the amount of costs in the period under review hasn't change. The lower a value of the index, the higher efficiency of the innovative modernization of economy is.

We propose such gradation of efficiency of innovative modernization of food industry. If I_{in} < 1 – development of economy of a branch is innovative. If I_{in} > **1.0 – a branch is under innovative stagnation. Indexes** I_{in} within the interval from **0.71 to 1.0 – characterize the low degree of modernization efficiency; the interval from 0.31 to 0.7 – the average degree; the interval from 0 to 0.3 –** the **high degree.** That is to say, the closer I_{in} value to zero (or the lower growth rates of resource intensity), the more effective modernization is.

Results of studies of the effectiveness of food industry innovative modernization, presented in Fig. 2, indicate that the development of economy of food industry in 2014 and 2015 was innovative and characterized by the average degree of modernization efficiency, because the index of innovativeness was in the range from **0.31 to 0.71** ($I_{in\ 2014}$=0.67; $I_{in\ 2015}$=0.54). In previous years, the economy of food industry was characterized by low degree of **innovative modernization** because the index of innovativeness was in the range **0.71÷1.0** ($I_{in\ 2011}$=0.99; $I_{in\ 2012}$=1.0; $I_{in\ 2013}$=**1.0**).

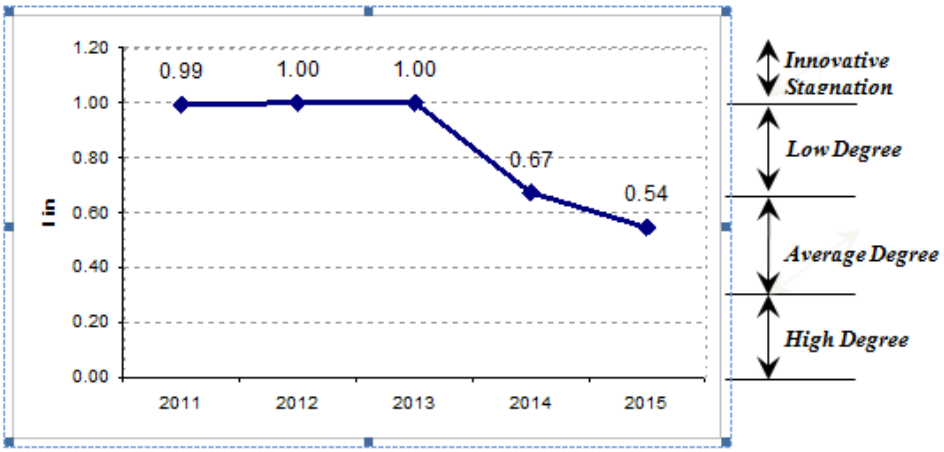

Figure 2. Effectiveness of modernization of the economy o food industry
(Source: authors' development)

The proposed approach can be used to assess the degree of efficiency of innovative modernization in particular branches of the food industry, with the difference that resource intensity is defined as the amount of costs of the relevant branch in a unit of added value (AV) in a certain period of time. Calculations of the indexes of innovativeness in the branches producing basic foodstuffs are shown in Table 3.

Thus, calculations of innovativeness indexes for the branches of food industry made it possible to determine degrees of the effectiveness of innovative modernization in 2015 (Table 3). The high degree was characteristic for the branches manufacturing milk products, oils and animal fats, products of flour and cereal industry, starches and starch products. The average degree of the effectiveness of innovative modernization is characteristic for the branches manufacturing bread, bread products, pastry products and beverages. The low degree of the effectiveness of innovative modernization is characteristic for the branches producing meat, meat products and other food products including sugar.

Table 3. Indicators of efficiency of innovative modernization in the industries producing basic foodstuffs

Branches of food industry	Total costs of innovations, thousand UAH		Added value in particular branches of food industry, million UAH		Resource intensity of innovative activities in particular branches of food industry, UAH per 1 UAH of added value		Index of innovati-veness (I_{in}) in 2015	Degree of efficiency of innovative modernizati on in 2015
	2014	2015	2014	2015	2014	2015		
Production of meat and meat products	34183.1	44531.7	6626.7	9529.4	0.052	0.047	0.91	low
Production of dairy products	477405.1	175557.9	6784.5	8476.2	0.704	0.207	0.29	high
Production of oils and animal fats	268533.7	9874.8	47564.6	36319.7	0.056	0.003	0.05	high
Production of products flour and cereal industry, starches and starch products	82808.5	30228.9	3466.9	6944.6	0.239	0.044	0.18	high
Production of bread, bakery and flour products	48604.2	27663.6	6671.5	10431.2	0.073	0.027	0.36	average
Production of drinks	247975.6	132513.3	10322.0	16162.4	0.240	0.082	0.34	average
Production of other food products (including sugar)	682330.8	842712.1	19996.2	28879.5	0.341	0.292	0.86	low

Source: Authors' Development

Conclusion.

The proposed methodical approaches to define the index of innovativeness **can be used to assess the degree of efficiency of innovative modernization of the food industry and its particular** branches. **Results of the study indicate that the competitiveness of the food industry can not be achieved without technological modernization, implementation of innovative technologies, products and services, which shall meet actual requirements of domestic and global market.** However we have to assert that the innovative development has not yet become the determining factor for the food industry of Ukraine.

The modern state of material and technical base of the food industry, which does not conform to the technological structure of developed nations, can not fully ensure transition to global standards. However, the achievement of the strategic goals of innovation development of food industry will only be possible when the nationwide negative developments, in particular: protracted political and economic crisis, unstable fiscal and monetary policy, inflation, expansion of foreign producers to domestic markets, etc. are overcome.

REFERENCES

1. Acemoğlu, D., Robinson, J. (2006). Economic Origins of Dictatorship and Democracy. Cambridge : Cambridge University Press, 433.
2. Gilman, N. (2003). Mandarins of the Future: Modernization Theory in Cold War America. Baltimore and London : The Johns Hopkins University Press, 344.
3. Przeworski, A., Limongi, F. (1997). Modernization: Theories and Facts. World Politics, 49 (2), 155–183.
4. Giljazutdinova, I.V. Metodika ocenki urovnja innovacionnogo razvitija proizvodstvennogo potenciala predprijatij v regional'noj hozjajstvennoj sisteme [Methods of assessing the level of innovation development of the productive capacity of enterprises in the regional economic system]. Available at: http://cyberleninka.ru/article/n/metodika-otsenki-urovnya-innovatsionnogo-razvitiya-proizvodstvennogo-potentsiala-predpriyatiy-v-regionalnoy-hozyaystvennoy-sisteme (In Russian).

5. Sadkov, V.G., Mashegov, P.N., Zbinjakov, E.A. (2006). Ocenka urovnja innovacionnosti ekonomiki i kljuchevye napravlenija formirovanija celostnoj mnogourovnevoj nacional'noj innovacionnoj sistemy [Assessment of the level of innovation of the economy and key directions of forming an integral multilevel national innovation system]. In VestRegion,1, 49–53 (In Russian).
6. Demin, S.S. (2011). Upravlenije razvitijem otechestvennoj naukojemkoj promyshlennosti v uslovijah innovacionnoj modernizacii proizvodstva [Management of development of domestic high-tech industry in the conditions of innovative modernization]. Bulletin of Moscow State Open University. "Economy" series, 3, 54-56 (In Russian).
7. Ushakov, D.S. (2009). Innovacionnaja modernizacija narodnohozjajstvennyh sistem [Innovative modernization of economic systems]. Moscow, 45 (In Russian).
8. Andrushkiv, B.M., Solotvins'kij, O.A. (2015). Modernizaciya pidpryiemstv yak konkurentna perevaga organizaciyno-ekonomichnogo rozvytku [Modernization of enterprises as a competitive advantage and economic development organization]. Coll. works Nikolaev National University V.A. Sukhomlynsky, 3, 198–203 (In Ukrainian).
9. Bilorus, O. (2012). Ukrainskyi shliah: systemna transformaciia i modernizaciia v globalizovanomu sviti [Ukrainian way: systemic transformation and modernization in a globalized world]. Research International Economics. Coll. Science. Works, 2 (71), 190, 3–20 (In Ukrainian).
10. Buzhymska, K.O. (2011). Modernizaciia ekonomiki: tekhnologichno-strukturnyi aspekt [Modernization of the economy: technological and structural aspect]. Bulletin Zhytomirskoho State Technological University, 3, 214-217 (In Ukrainian).
11. Valinkevich, N. V. (2014). Organizaciino-ekonomichna modernizaciia pidpryiemstv kharchovoi promyslovosti v umovakh innovaciinoi ekonomiky: problemy teorii ta praktyky : monografiia [Organizational and economic modernization of the food industry in terms of innovative economy: problems of theory and practice: a monograph]. Zhitomir: ZSTU, 439 (In Ukrainian).
12. Geiets, V. (2010). Liberalno-demokratychni zasady : kurs na modernizaciiu Ukrainy [Liberal democratic principles: a course on modernization of Ukraine]. Ukraine economy, 3, 4–20 (In Ukrainian).
13. Sabluk, P.T., Tofan, I.N. (2014). Ocinka modernizacii fundamentalnykh zasad diialnosti podatkovoi sluzhby [Evaluation of fundamentals modernization of tax service]. Economics of AIC, 4, 38–42 (In Ukrainian).
14. Sychevskyi, M.P., Deineko, L.V. (2015). Dosvid praktychnogo zastosuvannia teorii modernizacii u prodovolchii politytsi krain, shcho rozvyvaiutsia [The experience of the practical application of theories of modernization in food policy in developing countries]. Food resources, 4, 20–26 (In Ukrainian).
15. Chuhno, A.A. (2012). Modernizaciia ekonomiky ta ekonomichna teoriia [Modernization of the economy and economic theory]. European vector of economic development, 2 (13), 149–155 (In Ukrainian).
16. Shubravs'ka, O.V. Innovacionnaja modernizacija agrarnogo sektora Ukrainy [Innovative modernization of agrarian sector of Ukraine]. Available at: http://www.konspekt.biz/index.php?text=52817 (In Ukrainian).
17. Schwab, K. World Economic Forum. The Global Competitiveness Report 2015–2016, Insight Report. Available at: http://www3.weforum.org/docs/gcr/2015-2016/Global_Competitiveness_Report_2015-2016.pdf
18. Sychevskyi, M.P., Kovalenko, O.V. (2016). Chynnyky innovaciinoi konkurentosprmozhnosti kharchovoi promyslovosti v konteksti globalizacii [Factors of innovative competitiveness of food industry in the context of globalization]. Economy AIC, 11, 60–87 (In Ukrainian).
19. Shumpeter, J. (2008). Teorija ekonomicheskogo razvitija [Theory of Economic Development]. Moscow: Directmedia Publishing, 400 (In Russian).

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ON SOME METHODOLOGICAL ERRORS IN CALCULATIONS OF PROFITABILITY OF THE PRODUCTS SOLD

PARMACLI DMITRII, ***honored Doctor of Economic Sciences, professor.***
e–mail: parmad741@mail.ru

DUDOGLO TATIANA, ***Doctor of Economic Sciences, professor in Comrat State University.***
e-mail: dudoglo_tatiana@mail.ru

Abstract. *The essence of the concept of profitability of products sold is clarified, four indicators are proposed, both as a separate type of product and for the whole range of products. It is noted that they have the same economic meaning, and therefore each of them can be equally used in analyzing the effectiveness of manufactured and sold products. Formulas for the interdependence of some indicators from others are proposed, as well as their graphic interpretation. Typical inaccuracies in the interpretation and calculation of economic indicators of the profitability of products sold are given. The efficiency of the entire enterprise is recommended to be assessed using indicators of economic and financial profitability.*

Keywords: *product profitability, profit, costprice, income, calculation methodology, cost recovery.*
JEL: D2, F61, M21
UDC: 338.2

Formulation of the problem. Increase of profitability of sold production is the most important component of acceleration of economic development of the enterprise. In modern conditions of management, when the transition from a planned to a market economy is completed, there is a need for a clearer interpretation of the concept of profitability of products, a new look at the generally accepted methods of calculating and analyzing an indicator of such importance for each enterprise. However, the existing methodological base, as the analysis shows, contains significant shortcomings, discrepancies, which leads to bias, and often to the impossibility of comparing the indicators of profitability. In this regard, we should regularize both the methodology for assessing the achieved levels of profitability, and the features of their comparative analysis.

When calculating the profitability of products sold, enterprises use a system of indicators. However, both in training and in real production conditions, a clear distinction of the significance of each of them, as well as the interrelations between them, are not sufficiently substantiated. In this regard, it is relevant to study the methodological aspects of the calculations of these indicators. In addition, very often in the conduct of profitability calculations, serious methodological errors are made, which from the point of view of economic science is not permissible.

Analysis of recent research. Modern science is looking for new ways of assessing the achieved levels of profitability, adjusting the direction of scientific search associated with the development of the theory of efficiency. In this sense, the work of A.Shafronov, in which he justified a new approach to production efficiency, is of interest, believing that an assessment of profitability levels should be made on the basis of their comparison with planned (potential) indicators [1, p. 82]. A systematic approach to the assessment of economic efficiency, including the profitability of products, claimed Professor Gataulin A. [2, p.8].

Purpose of the article. The author aims to streamline the use of economic terms relative to the efficiency of products of operational activities, while excluding the possibility of discrepancies, and to familiarize the readers with new approaches to calculating the profitability of products sold, making them available for practical use in scientific research and practical activities.

Statement of the main results of the study.Statement of the main results of the study. Profitability indicators characterize the final results of management more fully than profits do, because their value shows the relationship of effect with cash or used resources. They are used to assess the activities of the enterprise and as an instrument of investment policy and pricing. More often in the practice of enterprises, the indicators characterizing the profitability of products, assets and investment

projects are calculated. It is very important to calculate the levels of profitability of each type of products sold, which allows us to identify the most profitable of them.
The economic efficiency of production and sales reflects the profitability and revenue. As is known, it is measured by such generalizing indicators as:

- *profitability of products sold*

$$P = \frac{П}{Z}, \text{ lei/lei} \quad (1)$$

- *profitability of sales of a given type of products*

$$P_{П} = \frac{П}{N}, \text{ lei/lei} \quad (2)$$

where: P - profit from the sale of products, lei;
Z – costprice, lei;
N - is the volume of sales, lei.

The profitability of the sold products shows how much profit is received from the sale of this product per 1 leu of costs, the profitability of sales is the same in terms of 1 lei of sales.

It should be kept in mind that in the practice of economic calculations, there are being used three forms of profitability indicators which have the same economic meaning [3, p.213]:

level of profitability

$$P = \frac{П}{Z} \cdot 100,\%$$

profitability

$$P = \frac{П}{Z}, \text{ lei/lei}$$

coefficient of profitability

$$P = \frac{П}{Z}$$

The generalizing indicator of the efficiency of production and sales of products includes the *recoupment of costs* (P_o) and *the input intensity* ($З_e$) [4, p.176-177]:

$$P_o = \frac{N}{Z}, \text{ lei/lei} \quad (3)$$

$$З_e = \frac{1}{P_o} = \frac{Z}{N}, \text{ lei/lei} \quad (4)$$

The cost recovery shows how many lei are received from the sale of products per 1 lei of costs, and the intensity, on the contrary, shows the amount of costs that an enterprise incurs per 1 lei of the products produced and sold.

Profitability of sold products, profitability of sales, recoupment of costs and intensity are indicators of the economic efficiency of production and sales of products. They have a single economic essence and, knowing one of them, it is easy to determine the rest (Table 1).

The interdependence between product profitability (P), profitability of sale ($P_П$), cost recovery (P_o) and intensity (Зе) can be represented graphically (Fig. 1)

Table 1. Interrelation of indicators of profitability of sold products

	Profitability of Sold products (P)	Profitability of sale ($P_п$)	Cost recovery (P_o)	Intensity ($З_e$)
Profitability of sold products (P)		$P = \frac{P_п}{1-P_п}$	$P = P_o - 1$	$P = \frac{1}{З_e} - 1$
Profitability of sale ($P_п$)	$P_п = \frac{P}{1+P}$		$Pп = 1 - \frac{1}{P_o}$	$Pп = 1 - З_e$
Cost recovery (P_o)	$P_o = 1 + P$	$P_o = \frac{1}{1-P_п}$		$P_o = \frac{1}{З_e}$
Intensity ($З_e$)	$З_e = \frac{1}{1+P}$	$З_e = 1 - P_п$	$З_e = \frac{1}{P_o}$	

Source: developed by the authors

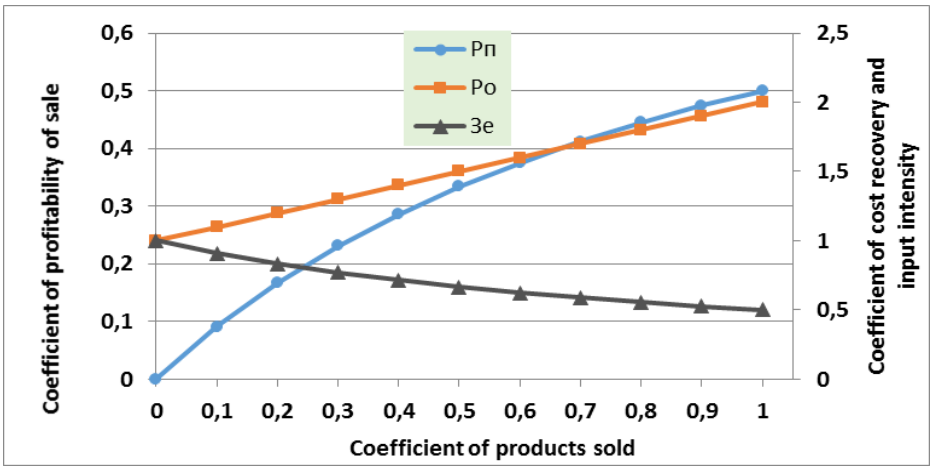

Fig.1. Dependence of profitability of sales, cost recovery and intensity from profitability of sold production

Source: performed according to data from Table 1

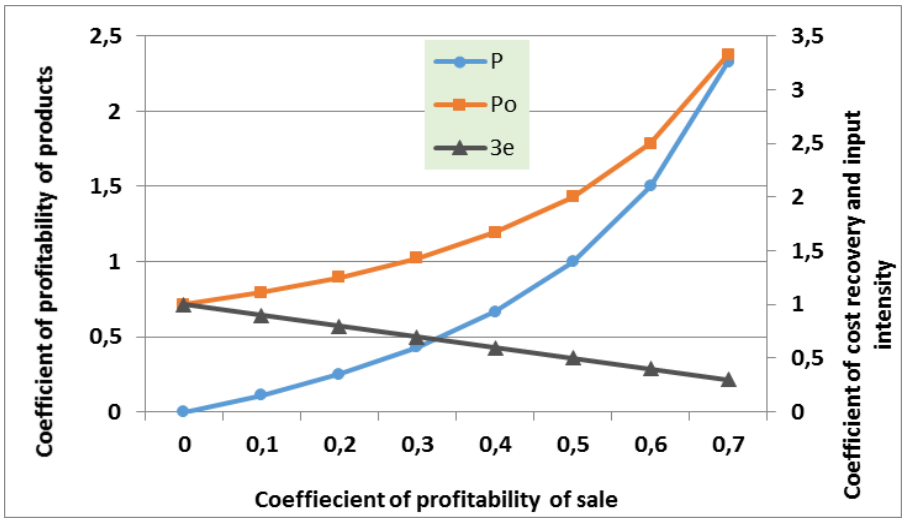

Fig.2. Dependence of product profitability, cost recovery and input intensity on sales profitability

Source: performed according to data from Table 1

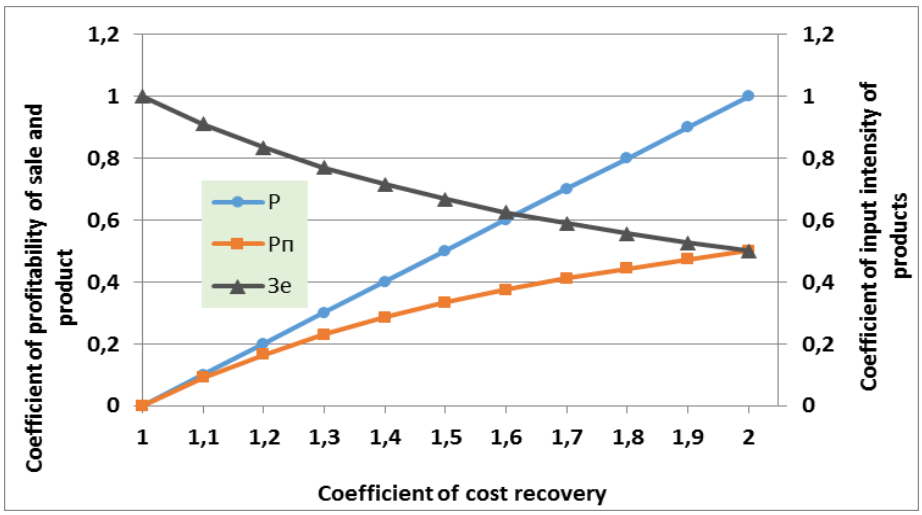

Fig.3. Dependence of product profitability, profitability of sale and intensity on cost recovery

Source: performed according to data from Table 1

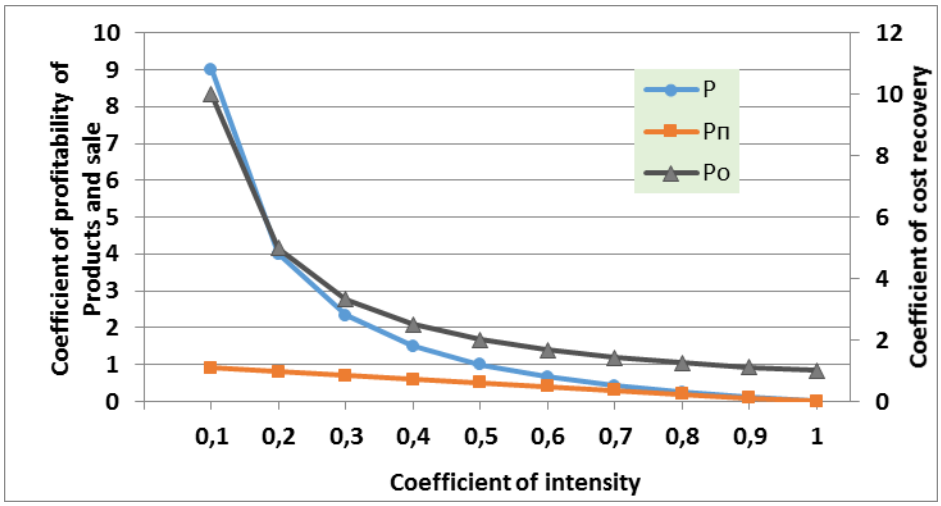

Fig.4. Dependence of product profitability, profitability of sales and cost recovery on the input intensity.

Source: performed according to data from Table 1

Using the above formulas, one can calculate the economic efficiency for each type of product (service). Given that the enterprise, as a rule, is not limited to the release of one type of product, it is important to assess its work related to the production and sale of the entire range of products.

It is also important to note that in calculating the effectiveness of products sold it is not correct to use profit before tax or the net profit of the enterprise. The fact is, that these types of profits are formed taking into account the indicators of the investment and financial activities of the enterprise, which go beyond the operational activities of the enterprise and therefore have no direct relation to it.

Here are some examples of incorrect recommendations for determining the profitability of products sold in domestic textbooks. Thus, in the textbook of N. Ciornâi and I. Blaj "The Economics of Modern Firms" it is emphasized on p. 214that "profitability, or the level of profitability, is expressed as a percentage" (other indicators are not provided) [5, p. 214]. And further "economic profitability is the ratio between gross profit and the amount of used assets, i.e. Average annual amount of fixed and working capital ". Thereare two inaccuracies in this statement:

- this statement does not take into account that in the calculations of economic profitability there could be additional income (losses) from the investment and financial activities of the enterprise, since in the numerator only gross profit is taken into account;

- the amount of used assets is the aggregate of own and borrowed capital, rather than the average annual amount of fixed and working capital as indicated in the quoted source.

In the textbook "Analysis of financial statements" by N. Ţiriulnicova and other authors on p. 91 it is stated that "in analytical practice one can find various variants of calculating the profitability of sales, depending on what profit is taken in the numerator when determining the level of profitability. So, in the numerator you can use gross profit, profit from operating activities, profit before tax and net profit. Based on this, you can calculate four indicators of profitability of sales". The last 2 profitability indicators, calculated on the basis of profit before tax (p.91) and on the basis of net profit (p. 92), do not have economic sense and therefore cannot be used methodically. On p.97, the profitability of the product is analyzed, which the author understands, in one case, as the ratio of the product's profit to the selling price, in another - as the ratio of the product's profit to the cost of the unit of the product sold. At the same time, as we see, the types of profitability are not subdivided [6, p.91-97].

It should be clarified that enterprises can determine the amount of profit from the sale of a particular type of product as the difference between sales revenue and cost. At the same time, we emphasize again that the taxable profit and net profit are formed taking into account three types of the enterprise's activities: operating, financial and investment. In this regard, accounting for the amount of profit before tax or net profit by type of product is not conducted at enterprises and therefore it is not correct to calculate the profitability of products with their use.

In order to prevent the use of profit before taxation and the net profit of the enterprise in calculating the effectiveness of the produced and sold products, as well as the efficiency of all operating activities, it is expedient to use the difference between income and costs (cost price) instead of the profit indicators in the numerator.

The economic efficiency of the enterprise's activity in the production and sale of all types of goods (services) is characterized by the following generalizing indicators:

Level of profitability of all types of products sold (P_{pn}):

$$P_{pn} = \frac{\sum_{i=1}^{n} N_i - \sum_{i=1}^{n} Z_i}{\sum_{i=1}^{n} Z_i} \cdot 100, \ \% \qquad (5)$$

Level of profitability of all types of products (P_{np}):

$$P_{np} = \frac{\sum_{i=1}^{n} N_i - \sum_{i=1}^{n} Z_i}{\sum_{i=1}^{n} N_i} \cdot 100, \ \% \qquad (6)$$

The level of costs recovery for the production and sale of all types of products (P_o):

$$P_o = \frac{\sum_{i=1}^{n} N_i}{\sum_{i=1}^{n} Z_i} \cdot 100, \ \% \qquad (7)$$

Intensity of all types of products (3_e):

$$3_e = \frac{\sum_{i=1}^{n} Z_i}{\sum_{i=1}^{n} N_i}, \text{ lei/lei} \qquad (8)$$

where: N_i – Income from the sale of all types of products;
Z_i – Prime cost of all types of products sold;
n – Number of products produced (types of products).

If we take into account that in addition to production activities the enterprise is engaged in financial, investment and other activities that are not connected with the production of goods or services, then the economic efficiency of the enterprise as a whole should be assessed with the help of economic and financial profitability [4, p. 180]:

- Economic profitability (return on assets)

$$P_э = \frac{П_{н.о}}{К_с + К_з} \cdot 100, \% \quad (9)$$

- Financial profitability

$$P_ф = \frac{П_ч}{К_с} \cdot 100, \% \quad (10)$$

where: $П_{н.о}$ – profit before taxation;
$К_с$ and $К_з$ – own and borrowed capital respectively.

In conclusion, we note that the proposed 4 indicators of profitability as a separate product, and the entire range of products have a single economic meaning, and therefore each of them can be equally used in analyzing the effectiveness of manufactured and sold products. The efficiency of the entire enterprise is recommended to be assessed using indicators of economic and financial profitability.

REFERENCES

1. Shafronov, A., New Approach to Production Efficiency ("Новый подход к эффективности производства"), Economist, 2003, Nr.4 – pp. 82-87
2. Gataulin, A., On Systemic Approach to Evaluation of Production Efficiency in Agricultural and Industrial Complex. Economics of Agricultural and Processing Enterprises ("О системном подходе к оценке экономической эффективности в АПК.//Экономика сельскохозяйственных и перерабытывающих предприятий ") – 2006, Nr. 8 – pp. 8-11
3. Parmacli, D. M., Shamin, A. E., Kovalenko N. Y., Agricultural Economics: Student Manual ("Экономика сельского хозяйства: учебное пособие"), Knyaginino: Nizhny Novgorod Institute of Economics and Management, 2015 – 246 pp.
4. Parmacli, D.M., Methodology of Scientific Research in Economics: Student Manual ("Методология научных исследований в экономике: учебное пособие") – Cahul State University "B.P. Hasdeu," 2011 – 257 pp.
5. Cherniy, N., Blazh I., Economics of Modern Enterprises. Text-book for higher educational institutions ("Экономика современных фирм. Учебник для высших учебных заведений"), Edition Prut International, 2003, 360 pp.
6. Tsiriulnikov, N. et. al., Analysis of Financial Reporting: Text-Book ("Анализ финансовой отчетности: учебник"), Ch.: Consultații în Domeniul Contabilității și Impozitelor SRL. 2005 – 376pp.

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ORGANIZATIONAL AND ECONOMIC PRINCIPLES OF FORMATION AND USE OF HUMAN CAPITAL OF UKRAINE'S AGRARIAN SECTOR OF ECONOMY

GRYNHUK U.S., Doctor of Economics
grynchuk1979@icloud.com

UTECHENKO D.M., a postgraduate student
dashautechenko@gmail.com
Bila Tserkva National Agrarian University.

Abstract. *In this article are considered the problems of the formation and use of human capital of Ukraine's agrarian sector of economy. The special attention is paid to the study of the root causes of unemployment and migration of rural population. The main attention is paid to the problem of self-employment research of the population that live in rural areas. And also in this article are proposed measures to reduce unemployment in rural areas.*

Key words*: agricultural enterprises, population, unemployment, self-employment, private peasant farming.*

JEL: J21, J24, J43, Q10
UDC: 338.43(477)

Significant changes and active social processes that take place in the village require the formation of new social relations, the central figure of which is a peasant, as a defining resource in production. In the present conditions of complicated socio-demographic situation in the countryside, job cuts in agricultural industry its productive employment which is realized in the field of work activity is a decisive factor in solving urgent problems in the industry. The question of employment of rural population increase of workforce productivity and productiveness on this basis improvement of economic relations with further structural rebuilding of the agrarian sector organizational forms of homekeeping widely researched by well-known scientists in particular mainly: V.G. Andriychuk, D.P. Boginya, O. H. Bulavka, V. S. Diyesperov, S. M. Zlupko, S. H. Kaflevs′ka, YU. M. Krasnov, D. F. Krysanov, H. I. Kupalova, E. M. Libanova, M. Y. Malik, L. I. Mykhaylova, O. I. Pavlov, V. M. Petyukh, I. V. Prokopa, P. T. Sabluk, V. M. Skupyy, L. O. Shepot′ko, O. H. Shpykulyak, V. V. Yurchyshyn, K. I. Yakuba and others.

However, in the conditions of a long crisis and the withdrawal of the state from the appropriate financial assistance to the countryside on the development of rural areas the question of the employment of the rural population requires further research. Special attention is required to study directions of formation functioning of employment in the countryside in the context of improving the demographic situation and social protection of rural areas restoration and development of social infrastructure of the village and rural areas. The foregoing defines the relevance of the article.

The development of rural areas directly depends on the quality of management of labor potential (laying the groundwork for its preservation and reproduction, creation of opportunities for effective application of labor activity, regulation of workers mobility, etc.) [1]. Assessing the state and prospects of improving the situation regarding the development of the labor potential of the villageand providing rural populations with jobs, we should focus on the following aspects: impairment of the value of rural labor and the provision of large agro-enterprises extensive agriculture; underestimation of the contribution of private farms (small landowners); shadowing of the rural labor market; destruction of social infrastructure and non-professional forms of support and development of human potential of rural territories; insufficient attention to the diversification of the labor market (to the non-agrarian employment); migration processes in rural areas.

Land is the fundamental national wealth that is under special state protection. (Constitution of Ukraine, Article 14). Removing the state from management. Removal the state from the state's management redistribution and common property in the countryside is the cause of the essential differentiation of the population is the cause of the essential differentiation of the income level of the population, possession of land and property. The land is actually concentrated in a small number of

owners, reduced the efficiency of the use of land, decreased profitability of small and medium-sized farms. Excessive concentration of land is turning into a monopolization of the agrarian market and lowering the efficiency of land use, the application of extensive technologies and outdated forms of labor organization, making the agricultural sector of Ukraine ineffective, and employment in it is not prestigious [2].

According to Ukraine's State Committee of Statistics in the first half-year of 2017 the number of employed population at the age of 15-70, which live in rural areas was 5.0 million people. Among the employed population in the countryside two thirds of them were hired, almost a third were self-employed, and 1.0% were employers and free-working family members. The employment rate of the population living in rural areas was 54.0% in the first half-year of 2016 – 54,3%),among the urban population - 56.9% (in the first half-year of 2016 – 57,1%). The number of unemployed people at the age of 15-70 in rural areas were 584.6 thousand people. In the first half-year of 2017 unemployment rate (according to the methodology of the International Labor Organization) in the countryside was 10.4% of the economically active population (in the first half-year of 2016 – 10,4%). The main causes of unemployment in the countryside are: seasonal nature of work and dismissed because of economic reasons and in urban areas – voluntary redundancy, negotiated resignation and also dismissed because of economic reasons.

Orientation of large farms for export, increase in the volume of cultivation of rapidly recovered and less labor-intensive industrial crops (which exhaust the earth) monopolization in the harvesting regions doesn't lead only to rising food prices and insufficient security the domestic market of certain food products, and also to the permanent dismissal of people employed in agriculture and reducing their income. Agroholdings actively reduce the number of employees (ensuring employment only the fifth part of the able-bodied rural population) and reduce the cost of wages [3]. Share of annual wages fund in the cost of production of agricultural enterprises - 9,7% (if the profitability is not less than 50% - 4.7%). Competitive advantages of domestic agricultural products are achieved largely due to the exploitation of the land (step of development of the land fund - 72%) and cheap labor [4]. Heads of enterprises often do not comply with the requirements of legislation about the size and terms of payment of wages [5].The average wage of agricultural workers in August 2017 was 5797 UAH, which is 7.9% less than in July 2017, but 48.9% more than in August 2016.

Ukrainians are massively dissatisfied with the level of their wages. Recent studies have shown that 72% of respondents are very dissatisfied with the level of their wages, 18 are dissatisfied, 6 are partially satisfied and only 4% are satisfied. Unfavorable wage conditions push the most active part of the population towards labor migration. The total number of illegally employed and labor migrants is now estimated at more than 8 million people.

Wages are not the main source of money for the peasants (42.5% of their cash income in 2011). For 55% of the rural population, the main way of self-sufficiency is the management of private plots. In the conditions of the crisis state of employment in large-scale agricultural production, private economy became a means of survival and the main area of application of labor peasants. Production in personal peasant farming with land use up to 1 ha (56.3% of the total number of personal peasant farming) is directed primarily at satisfying the needs of the family. The most active part of the rural population combines farm management with trips to earnings to cities [6]. The productivity of personal peasant farming is low, labor is mostly natural with difficult and inappropriate conditions. however, small volumes of production make investments in personal peasant farming mechanization unprofitable. Due to the low level of development of rural territories, small size of land, lack of financial assets, equipment, high prices for means of production (seeds, cattle, which are purchased at retail prices), low quality of infrastructure and lack of access to outlets and so on personal peasant farming can not get proper added value and provide a positive cycle of accumulation and investment (or spend a significant part of it on intermediaries) [7].

Members of personal peasant farming are in less favorable conditions than engaged in other types of activities. Art. 4 of the Law of Ukraine "On employment of the population" relates members of personal peasant farming to the busy population keeping repeatedly criticized the norm of the Law of Ukraine "About amendments to some laws of Ukraine on reducing the impact of the global financial crisis to the sphere of employment of the population " No. 799-VI dated 25.12.2008).

Members of personal peasant farming are considered to be busy when personal peasant farming work for them is basic, and calculated monthly income per member of personal peasant farming equal to or greater than the minimum wage [8]. However, the size of a plot of land per member of personal peasant farming often do not provide a real opportunity to ensure their actual employment and receive income from farming,which would be enough for normal existence. Besides for the population which is self-employed in agriculture or working on personal household plots there are not any requirements for payment of insurance premiums to the matching funds, therefore, in the event of the loss of the possibility of carrying out its activities, they can not count on an adequate level of social protection of the state [9]. The current procedure for recording activities of personal peasant farming is also problematic, in particular in the part to the acquisition or loss of membership in it, which does not allow many peasants in need of unemployment benefits to receive appropriate public employment services.

Although the part of personal peasant farming in the gross production of agricultural products made up more then 55% they do not have any impact on the market (55% of the total land area belongs to large enterprises). Personal peasant farming - the leading supplier of agricultural products to the domestic market - do not have even the support of the state, which preserves their low productivity, reduces motivation to agrarian labor and strengthens a welfare mentality in the village [10].

There are some unsolved questions of accounting work experience for the members of personal peasant farming, adequate pensions, insurance against accidents and other types of social protection. In accordance with the legislation of Ukraine activities related to the conduct of a private peasant farm, does not belong to the business. Insufficient legal regulation of the activity of such farms, the status of employed persons, lack of proper state support, cause considerable difficulties for the peasants working there, leads to the existence of a "shadow" labor market.

Low productivity of rural economies is due not only to the insufficient level of application of agricultural technologies, but also a significant shadowing of the stages of supply chain: because of decline indicators of productivity one third of trade turnover is in the shadow [11]. The level of shadowing of the domestic agrarian sector is estimated in the range of 15-20% (contribution to informal GDP according to the results of the first quarter of 2012, about 1.5 billion UAH). Shadowing also determines employment of rural population: in the age group of 15-49 years, the employment rate in the informal sector in 3.5 times, and in the group of 50-70 years - in 5 times higher than the corresponding indicator for the urban population. The point at issue is about unregistered production units of households, and about individuals and legal entities, which work without the conclusion of employment contracts, and about unlicensed activities in the sphere of harvesting and selling berries, mushrooms, timber, fish, etc. The shadowing of rural employment increases the burden on social insurance funds, from which the relevant persons receive funds in connection with poverty and unemployment, though, some of them are not poor or unemployed [11].

According to the results of a sociological research among rural youth conducted by Ukraine's State Committee of Statistics it was found that out of almost 426 respondents 29.4% are dissatisfied with their work.

The low prestige and unattractiveness of labor in the countryside for young people is mainly explained by the lack of proper production, labor, material, socio-cultural and living conditions of work and living.

In particular, this is proved by a survey of school leavers of general academic schools and also educational institutions on the direction of the agricultural profile. So they do not want to work in this industry because the salary is low – 31.2% of the respondents; low level of mechanization of production processes - 24.7; the work is not prestigious and unattractive - 16,4; imperfect organization of labor - 11.4; unsatisfactory sanitary and hygienic working conditions - 10.5; limited choice of occupations, specialties, jobs - 5.8%.

Speaking about the forms of management, the respondents preferred cooperatives, small and joint venture companies. According to the number of people willing to work in agriculture, the abovementioned enterprises came in the first place (44.3%), private farms of citizens - on the second

(19.2%), then - agricultural enterprises (17.2%), farms (14.3%) and state agricultural enterprises (5.0%).

Gives rise to concern the fact that every fourth of the respondents will work in the village for the time being, but at the first opportunity will try to move to live and work in the city. Consequently, they can be considered potential migrants. However, the desire and intentions of children in this support a significant part of their parents. So 39.3% of the respondents answered that their parents want them to work in the city, and 27.3% - to live and work in the village.

As the study shows, in this way, for most graduates of rural schools,which have already been trained as cadres for agriculture this industry is not prestigious for their work. At the same time, in the process of agrarian transformations, the emergence of market relations in a certain part of rural youth, there is an interest in independent management and entrepreneurial activity. So, every fifth respondent wants to organize his own business and set up his own agricultural enterprise. The proportion of those who wish would be even greater if favorable conditions were created, as the development of entrepreneurial activity hinders in their opinion (in order of priority): impossibility of profitable sales of products, lack of initial capital and inaccessibility of credit, insufficient level of education, opposition of managers of different levels, difficult economic and political situation, etc. [12]. At the same time, youth admit: various forms of ownership of agricultural land (46.2% of respondents), private (29.7%), collective (14.6%), state (9.5%). Young people are more loyal than other categories of people to work for a fellow villager, relative, or other private entrepreneur. Effective management of the labor potential of the village requires improving living conditions, work, life, leisure of the population; improvement of the demographic situation; strengthening the stimulating and reproductive function of wages; creating conditions for an effective combination of family and work responsibilities [13]. It is important to equalize internal and interregional imbalances (including between urban and rural areas), but this area requires significant financial, managerial and institutional resources.

The current Law of Ukraine of October 17, 1990 No. 400-XII "About priority of social development of the village and agro-industrial complex in the national economy" still remains the only act that determines real measures for the social development of the countryside, providing a list of priority organizational, economic and legal measures to be implemented in rural areas. In particular, the minimum size of state centralized investment aimed at strengthening the material and technical base of the social sphere of the village and agro-industrial complex should be at least 1% of GDP (for the construction of non-productive purposes in rural areas, at least 50% of state investments provided for by this Article shall be directed). However, the Law is not being implemented, especially in terms of providing the village with a city advantage (per capita) in the construction of housing, educational facilities, culture and sports, health, life, trade, gas, water and electricity, communal facilities, etc., as well as providing high-quality medical, cultural, sports, communal, transport and trade services for the village [14].

The analysis of statistical data shows that the overwhelming number of villages is outside the scope of social services. According to Ukraine's State Committee of Statistics villages are not provided with schools today - 51.4%, 70.8% of villages do not have children's kindergartens, 41.2% - institutions of club type, 46.6% of the total number of villages do not have required for each village doctorate-obstetric item. There are not ahy objects of social infrastructure in villages with a small number of inhabitant, household services almost completely decreased in the countryside. The problems of the improvement of villages, housing and utilities and engineering support are being solved at a fairly slow pace. A little more than 40% of rural streets have a solid coverage and are lighted [15]. From 1990 to 2009, the village educational network of institutions across Ukraine decreased by 3.8 thousand preschool institutions, or 69.8%, 1.6 thousand general educational establishments, or 89.4%, 4.5 thousand cultural buildings, clubs, or 78.6%, 1.3 thousand paramedic and obstetric centers, or 92, 1% and so on. The retail network in general was down by 46.6 thousand stores, or by 23%, by 10.5 thousand catering establishments, or 42.6%. According to the aforementioned socio-economic research made by Ukraine's State Committee of Statistics in rural settlements, not all social facilities function. Due to the lack of funds for their reconstruction, repair and maintenance for their intended purpose, only 63.2% of households are operating in Ukraine,

78.9% of children's preschool institutions, 97.3% of shopping centers. Even not all primary schools (95.5%) and hospitals (99.3%) are functioning.

The provision of social infrastructure objects has a clear tendency to decrease - now there is one hospital in 29 villages, a kindergarten - in three villages, a school, a clubhouse and a nursing and midwifery point - in two villages. According to Ukraine's State Committee of Statistics 70.8% of the total number of settlements in Ukraine did not have children's kindergartens, including 36,5% with the number of children under 6 years of age - 20-50 persons and more, in 51.4% of settlements there are no schools, 36.5%, where the number of 7-17 year-old children and young people was 20-50 people or more.

The level of social adjustment of the village settlement and rural areas in general can only be achieved by comparing the volumes and qualitative characteristics of their condition in space and time.

First and foremost, for this purpose, priority directions of development of social development of rural areas should be determined, taking into account the availability of financial support for it.

However, in the state and local budgets there is not enough money not only for the construction of new ones, but also for the maintenance of functioning social infrastructure objects. The Ukrainian village is in a financial decline, so there are many problems in this regard. Almost completely suspended social development processes [16].

Thus, in 2016, due to all sources of funding, the total housing area was put into operation by 16.6% less than in 1990, built apartments for 1 thousand people by 57% less, only 5.2 thousand pupils' places were put into operation in general education schools, which is 8.5% of the places introduced in 1990. And this despite the fact that the expenditures on education in Ukraine in 2016 amounted to 23.9 billion USD and against 2008 increased by 11.0%.

With expenditures on health care UAH 7.5 billion. only 48 beds in district hospitals and 212 beds in outpatient clinics were introduced in the village, which, before the introduction of such in 1990, was 0.8% and 1% respectively. A similar situation has arisen regarding the introduction of other social infrastructure objects.

The transfer of communal property of social infrastructure objects belonging to agricultural enterprises is not provided by filling in local budgets with appropriate finances, and agroholdings, as a rule, do not see the need to create (support) social infrastructure facilities, although it increases the attractiveness of the territory, contributes to the improvement of the quality of labor potential, inhibits the disappearance of the able-bodied population, the destruction of settlements and non-agricultural spheres of the rural economy. In turn, increasing the well-being of peasants and solving their social problems is possible only thanks to the integrated development of rural areas by increasing the growth rates of labor productivity, increasing productive employment (including non-agricultural areas), and developing entrepreneurship. Decrease in the level of employment, lack of quality jobs, destruction of non-agricultural sectors and low opportunities for alternative employment in rural areas. In Ukraine, the employment policy is implemented through state and regional programs aimed at supporting vulnerable groups of the population (persons with disabilities, youth, women, elderly persons),however, the proposed measures, mainly aimed at adapting the labor market to the existing economic realities, and they do not solve the issues of efficient employment of the population.

In the early 1990's rural areas were considered labor-free, but since 1994, the unemployment rate of peasants exceeds the same indicator for urban population. In 2009, the negative situation was complicated by the partial return of peasants released in the cities due to the financial and economic crisis. At the end of 2012, the burden on one job in agriculture was 55 people (from 14 in the Crimea to 608 in Lugansk region and 302 in Cherkasy region). At the end of 2011, a similar figure was 43 people per one vacant place (from 16 people in place in the Crimea to 164 people in one place in Cherkasy region). Although the above statistics do not fully reflect the state of things, because it is calculated only for agricultural workers (data on nonagricultural employment in the reporting "Number of rural unemployed and agricultural workers and their employment by region" are not given), but it shows that the problem of rural unemployment has become much worse.

Over the years of market transformation, a category of rural population has emerged, unemployed people, who for a long period of time can not find work and from year to year, their number increases slowly. According to statistics, in 2009 in Ukraine, the unemployed of able-bodied

age in the village were 502.0 thousand people, or 8.2% of the total number of economically active population, and in cities - 1454.6 thousand people, or 10 , 2% of the total number of economically active inhabitants.

Certain changes occur in the age structure of the rural population. In the context of the general tendency towards a decrease in its number, the group of able-bodied people increased, which is important for the reproduction of the rural labor resources.

At the beginning of 2010, the load of one vacant workplace by skilled workers in the sectors of agriculture, forestry and fisheries was 53, which is today the largest among the remaining occupational groups.

The given data testify to the significant negative impact of market agrarian transformations on the employment of rural population. It can be stated that the consequence of this was a significant narrowing of the possibilities of employing labor in the countryside, as we have already noted. Certainly, the special tension and pressure on the rural labor market has led to too much reduction in the level of employment in agricultural enterprises.

At the same time, the industrial and processing enterprises stopped working, the scope of service was curtailed, the construction in rural areas declined, etc., which also substantially increased the above-mentioned tendencies of employment in the countryside.

The change in the natural base of employment formation is mainly influenced by the change in the size of the rural population and population of villages. Therefore, for their self-sufficient development, the most important problem of the present is the replenishment of labor resources in agricultural production and processing industries of agricultural activity. It is extremely important at the same time not to exclude from the field of view the social and ecological functions concerning the organization of workplaces in one or another rural area.

It is known that the best opportunities for employment and professional growth existing in cities, where, respectively, higher wages and real incomes, better working and living conditions, and the ability to meet diverse needs were always attracted by peasants and especially rural youth.

These factors are the main reason for the depopulation of villages and the reduction of settlements.

It is possible to identify long-established trends in the countryside, primarily related to the economic situation in agriculture. Undoubtedly, the general demographic situation in the countryside, in particular, depopulation processes, changes in the age structure, aging and extinction of the inhabitants is the most noticeable factor of influence.

It should be noted that the real state of unemployment is much worse than officially registered. That is, the phenomenon of hidden unemployment, the volume of which, according to various estimates, reaches 30-50% of the number of employed.

Thus, according to the calculations of the Institute of Economics of the National Academy of Sciences of Ukraine, hidden unemployment in the agrarian sector of the economy reaches an average of 38% of the total number of employees. In general, in the village, the amount of hidden unemployment is 900-950 thousand people, while the actual unemployment rate of the working-age population in rural areas is estimated at 2 million people.

The level of agricultural development in Ukraine (72.0%) is such that there are almost no reserves of extensive involvement of new lands. Thus, the resources of the hired labor of the peasants in the agrarian industry are almost exhausted, which, in the absence of a choice of economic activities, is the main source of income generation. The solution of the problem of rural employment lies outside the sphere of agrarian production as such, and it is necessary to focus on the diversification of forms of employment in the non-agricultural sector of the rural labor market, with which the development of the village is closely linked.

The development of non-agricultural employment, absorbing the labor force released from agricultural enterprises and households, will significantly expand the scope of rural labor attraction; to form a multi-sectoral employment structure of the rural population; slowing down the pace and minimizing the negative effects of rural migration; create conditions for the consolidation of youth in the countryside through the development of productions that require high qualifications; increase rural incomes and reduce poverty, increase labor mobility; to form employment focused on the value

orientation of different social strata of the rural population [17]. Multifunctional development will contribute to reducing the dependence of rural areas from economically developed cities, as well as provide an opportunity to increase the number of employed people among categories that need additional support in the labor market. The most important sectors in terms of rural employment are the processing industry, wholesale and retail trade, transport and education.

Non-agricultural employment can offer alternatives for the development of labor or professional development, which for individuals are more attractive than agriculture. The experience of the countries of the European Union reflects that rural areas, where non-agricultural employment growth is observed, changed the characteristics of the rural environment. Trade with non-agricultural products, transport networks and a wide range of services focused on production, consumer and entertainment needs, significantly strengthen the links between cities and rural areas nearby. This approach enables rural residents to have better opportunities, reduces the gap in quality of life between rural areas and cities.

Given the above policies directed at rural areas, it should focus on providing incentives for employment in the non-agricultural sector, as well as on the ability of households to meet these incentives. Implementation of state support in the direction of rural development should be concentrated on the combination of related activities of the "yellow box" (development of individual enterprises, industries) to the unrelated support of the "green box" (administrative costs, rural development, breeding, education, land reform, environmental protection) - measures for the development of rural areas. This would increase the efficiency of using budget funds in the agrarian sector and ensure the development of rural territories.

Due to the low wages in agriculture, villagers are trying to find employment in other sectors of the economy (only 60% of the peasants work in the place of residence) [18]. This is most characteristic of young people, which affects the decline in fertility in the countryside, aging of the population, reducing the number of workers and deteriorating the quality of the labor potential of the village.

It should be noted that the average size of youth earnings in rural areas is less than in urban areas, and in the agricultural sector it is one of the lowest in comparison with other branches of the economy. It is through low wages that full reproduction of the workforce is not ensured and there is no possibility to properly maintain the family, a significant part of rural young families have incomes, they do not provide the subsistence minimum. In addition, the amount of wages is almost not coordinated with the results of the work of employees. Besides, arrears in the payment of wages. Labor remuneration is often replaced by various types of in-kind payments and, in fact, has lost its stimulating role in increasing labor productivity, performing only an accounting function.

In the opinion of half of the respondents, their families do not always have enough money, although they save on everything, even on food. All of the above factors led to the fact that 82.8% of young people see improvements in the living standards of the villagers primarily due to higher wages. That is why half of the respondents assess their financial situation in comparison with other villagers as: below the average - 28.1%, low - 18% and very low - 3.3%, which does not contribute to the welfare and creation of young families, does not stimulate birth children, undermines health and causes social and psychological stress.

The employment analysis conducted in the village, particularly young people, shows in general that its interbranch structure is deformed. In the branches of material production work more than 80%, and only the rest in the non-productive sphere, in education, culture, health care, household services, etc.

Too many rural youth have abandoned the attractive labor on farms, complexes, and in the processing industry, because all this industrial work in the past.Cooperative associations and cooperatives require much less workforce. But its carriers, education and quality must be much higher than the previous criteria and must fully comply with international standards.

Currently, there is a direct proportional trend in the growth of the number of employed people at the place of residence registration by type of economic activity and the number of inhabitants in rural settlements. Thus, in rural settlements with a population of up to 50 people, the percentage of employment is 26.8%. At the same time, in densely populated areas - up to 50%. Thus, more than 70%

of inhabitants of rural settlements with a population of up to 50 people migrate. It should be noted that almost 1,300,000 employed people work in urban settlements, 384 thousand people - outside the region, 205 thousand people - abroad.

According to the results of a survey of rural migrants in the Khmelnytsky region, individuals (age groups 18-29 and 30-39 years old) are the most physiologically suitable for reproduction of the population (65.7%), including women (81.6%) who have been abroad for a long time, that is, with a separation from the family.

This undoubtedly negatively affects the process of reproduction of labor potential.

According to the level of education received - 42.2% of the persons have higher education, which makes 42.2%, including - 36.8% of women.

According to respondents' survey, in the studied region, the most important reasons for labor migration are the low salaries of rural residents - 39.2% and the lack of work - 40.2%, as well as: absence of work in the specialty - 2.9 %; lack of permanent work - 13.8%; other reasons - 3.9%.

Regarding the duration of labor migration, the situation is as follows: up to 3 years - 19.6%, including women - 28.9%; 3-5 years - 39.2%, including 39.5% of women; over 5 years - 41.2%, of which 31.6% are women.

According to the directions of labor migration, the following is typical: 26.5% of respondents in the studied region work or worked in the CIS countries. Among them more than 90% of migrants are employed in Russia, in particular in Moscow and Moscow region, Tyumen region, St. Petersburg.

According to the analysis, 73.5% of the interviewed respondents work in other countries, in particular in Portugal, Spain, Italy, England, Germany, Poland, Czech Republic, Greece, Canada, the USA, etc.

Studies show that more than 90% of respondents want to return to Ukraine provided that the following socio-economic issues are resolved:

- ensuring sustainable development of rural areas and rural social infrastructure, meets international standards and norms - 8.8%;
- availability of work in the specialty and proper social and living conditions - 20.6%;
- adequate wages, guarantees of social payments and an increase in the total income of the rural population - 60.8%;
- bringing the current legislation of Ukraine in line with international standards on social protection, stimulation and development of entrepreneurship - 9.8%.

Among the main social consequences of the migration of Ukrainian peasants, which are closely interrelated, one should highlight the following: rapid rates of aging of the Ukrainian village and an increase in the indicators of the demographic burden (the ratio of persons of incapable working age to persons of working age); as a result of a decrease in the population (density) of rural residents, the process of destroying the settler's land was accelerated. The migration caused a sharp aging of the rural population. In almost half of the regions of Ukraine, the proportion of rural residents older than working age reached a third or exceeded this amount. According to Kharchuk S.A., only about 10% of the total share of young people entering into working age remains at work in agriculture. The number of agrarian workers in the rural settlements remote from the cities is especially intensive [19].

The level of participation of the rural population in labor migration is twice higher than in the urban one - 8% of the rural working-age population (4% of the urban working-age population) are attracted to them. This is due to the fact that the rural population is more motivated to find work abroad, since it has much less opportunities to find employment in the community. The most common types of economic activity of labor migrants from the rural population were construction (59.8%), domestic work (16.8%) and agriculture (9.1%). It should also be noted that almost half of labor migrants from rural areas (47.5%) were young people (15-34 years).

It is difficult to determine the volume of labor migration in Ukraine. The main source of statistical information on migration in the state statistics bodies is the data of filled arrival / removal registers showing only the transfer from one place of permanent residence to another but does not reflect the actual picture of migratory flows.

The rapid growth of the proportion of people of working age in the total number of peasants increases the economic burden on the able-bodied population. The decrease in the number of villagers

in Ukraine is allegedly in line with world trends, but there is no redistribution of jobs to adjacent sectors that are serviceable for the direct production of agrarian products (supply of means of production, production and technical maintenance, harvesting, processing, storage, transportation and sale products, road transport, communications, etc.). So, the main task is not to preserve the number of rural residents per se, but in conjunction with the optimization of the division of labor in rural areas and the diversification of employment.

The state must shape the behavior of economic actors, primarily employers, on the principles of sustainable development (with an emphasis on the social component of rural development, effective management, de-agrarization of employment and preservation of the natural environment of the village). From the point of view of state policy, attention should be focused on the effectiveness of investments in the social sphere, and the priority should be the optimization of the labor market and the sphere of labor relations (including ensuring compliance with the current labor legislation by employers, supporting personal peasant farming , promoting de-agrarization of employment, etc.). To mitigate the problem of rural employment, it is necessary:

In addition to promoting the growth of profitability of agricultural enterprises, including through increasing labor productivity, state policy should be aimed both at encouraging owners of agro-enterprises to increase the share of the wage fund for hired labor for peasants (wages should become the main part of personal income), and control over the strict observance of legislation by owners in this area from outside. In the absence of state control, large landowners will continue the policy of understating wages and purchasing prices for products of small agricultural enterprises (including personal peasant farming).

To ensure the growth of personal incomes of the rural population, it is necessary to promote the intensification of production in enterprises and in personal peasant farming by:

- development of state policies aimed at supporting a small agricultural producer. In particular, despite the fact that the development of domestic agro-production occurs in conditions of an increase in the number of personal peasant farming with mechanized labor and irregular working hours, to direct the state's assistance to provide personal peasant farming with small mechanization facilities or to promote the formation of enterprises (cooperative associations) that provide personal peasant farming with the relevant services. Concentrate state and regional agrarian policy on establishing integration links between personal peasant farming and other sectors (marketing, processing, etc.) and creating an infrastructure for support;
- implementation of policies aimed at the formation of commodity-type farms (including personal peasant farming), expansion of volumes of intensive crops production and livestock breeding development;
- to facilitate the conduct of a small agricultural producer of production to promote the development of production cooperation and the introduction of a system of non-financial state support. Cooperation also provides for the merger in the following areas: processing and sale of products; supply of means of production; crediting; production service. Non-financial state support should include: state regulation of product sales (monitoring and forecasting prices); analysis of samples of soils, water, animal health; providing advice for various manufacturers' industries; promotion of transportation of products. It is advisable to introduce the construction of centralized state and private storage facilities and create a system of crop insurance;
- raising the professional level of managers of farmers and private farms in agricultural higher and secondary specialized educational institutions and setting up advisory services to assist agricultural production in oblasts and regions.

REFERENCES

1. Gavrilko P.P. Priorities for the Preservation of Labor Potential of Rural Territories [electronic resource] / /P.P. Gavrilko // Effective Economy. - 2012. - no. 5 - Access Mode http://www.economy.nayka.com.ua/index.php?Operation=1&iid=1149

2. Melnyk S.V., Retvtsev I.V. Problems of employment of the rural population of Ukraine [electronic resource] / Ed. Y. V. Kosinska - Lugansk: Research Institute for Labour and Social Affairs, 2011. - 64 p., p.9 - Access Mode: http://www.lir.lg.ua/docs/zanjatost_sela_2011.rar
3. Explanatory Note to the Draft Resolution of the Verkhovna Rada of Ukraine "On the Concept of Land Reform"
4. Problems and Perspectives of Development of Rural Territories of Ukraine (on the example of the Carpathian region): Scientific and Analytical Report / [V. V. Borschevsky, H. M. Prytula, V. Y. Krupin, I. M. Kulish]; National Academy of Sciences of Ukraine. Institute for Regional Studies; [Sc. Ed. V. B. Borschevsky]. - Lviv, 2011. - 60 pp.
5. Popova O.L. Social and Environmental Parameters of Agricultural Enterprises: Differentiation by Economic Classes / O.L. Popova, L.L. Pankratova, M. Betliy // Economy and Forecasting. - 04.2010. - p. 110 - 125.
6. Popova O. L., Social and Environmental Parameters of Agricultural Enterprises: Differentiation by Economic Classes / O. L. Popova, L. L. Pankratova, M. Betliy // Economy and Forecasting. - 04.2010. - pp. 110 - 125.
7. Ledel M. A., Gazuda L. M., Gotko N. M. Foreign Practice of Rural Development Management: Transformation of Experience for Ukraine. - Agroincom. - 2012. - no. 4-6. - pp. 66-74, p. 66
8. Ukrainian Model of Agrarian Development and Its Socioeconomic Reorientation: Sc. Doc. / [O. M. Borodina, V. M. Heyets, A. O. Gutorov et al.]; for ed. V.M. Heyts, O.M. Borodina, I. V. Procopa; National Academy of Sciences of Ukraine, Institute of Economics and Predicted. - k., 2012. - 56 p. p. 9
9. Zalizko V. D. The Impact of Agricultural Holdings of Agricultural Enterprises on the Socio-Economic Development of Rural Areas / V. D. Zalizko // Economy of Ukraine - 2013. - no. 6 (619). - pp. 71-78.
10. Dovzhuk B., Transformation of Rural Employment in the Conditions of Agrarian Reform // Ukraine: Aspects of Labor. - 2013. - no. 3 - pp. 16-21.
11. Mahsma M., Modern Tendencies in the Payment of Labor Employed in the Agrarian Sector // Ukraine: Aspects of Labor. - 2015. - no. 6 - pp. 3-7.
12. Tetkin V. I., Improvement of the State Policy of Social Development of the Village // Economy of the Agroindustrial Complex. - 2015. - no. 11 - pp. 19-24.
13. An Analytical Report to the Annual Address of the President of Ukraine to the Verkhovna Rada of Ukraine "On the Internal and External Situation of Ukraine in 2015". - K.: Niss, 2015. - 684 pp.
14. System Weaknesses in the Ukrainian Labor Market and Priorities for its Reform: Analytical Report / Ed. Y. A. Zhalila. - K.: Niss, 2010. - 47 pp.
15. Theory, Policy and Practice of Rural Development / Ed. Dr. Econ. Sciences, Corr. Casu, O. M. Borodina, Dr. Econ. Sciences, Corr. Uaas IV Prokopy; National Academy of Sciences of Ukraine; Institute of Economy and Forecasting, 2010. - 376 pp.
16. Mogilny O. M., State Policy in the Development of Rural Areas / A. M. Mogylny // Economy of the Agroindustrial Complex. - 2010. - No. 10. -pp. 125-131.
17. Kudla N., Multifunctional Development of Rural Territories from Basic Ideas to Activating Local Entrepreneurship / N. Kudla // Economy of Ukraine. - 2008. - No. 1. - pp. 62-71
18. Talan M., Employment in the Countryside: Problems and Perspectives / M. Talan, V. Berlinsky // Man and Labor. - 2006. - no. 9. - pp. 17-20
19. Harchuk S. A., Organizational and Economic Factors of Increasing Employment in the Village / S. A. Kharchuk // Agroinkom. - 2010. - no. 4-6. - pp. 81-84.

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CLIMATE CHANGES IN UKRAINE: AGRARIAN ASPECT

PROKOPENKO KATERYNA,
PhD in Economics, senior researcher,
e-mail: k_prokopenko@ukr.net,

UDOVA LYUDMILA,
PhD in Economics, senior researcher,
Institute for Economics and Forecasting,
National Academy of Science of Ukraine,
Kyiv, Ukraine
e-mail: u_lyudmila@ukr.net

Abstract. *The article identifies and substantiates the challenges and prospects of agriculture under the climate change. Ukrainian agriculture serves as an important component of global food security, whose further development is dependent on natural resources, the environment and climate change. Agriculture is a significant source of greenhouse gas emissions, however, at the same time, it is suffering from the climate change itself. Although Ukraine is not included in the list of the most vulnerable to global warming regions on our planet, if no appropriate urgent action is taken, the climate change will continue to pressure on the agricultural ecosystems.*

The authors highlight positive (changed terms and conditions of harvesting, increased efficiency of fertilizers, etc.) and negative (deterioration of grain quality, increased frequency of droughts, etc.) effects of the climate change on agriculture; they identify and summarize the main measures to reduce the negative impact of agriculture on climate change and propose various basic adaptation measures that would mitigate the negative impact of the climate change on agriculture.

Under the conditions of climate change, an important factor in improving the efficiency of agriculture is a rigorous distribution of arable lands between separate crops with regard to climate change. One of the important measures to improve the crop rotation pattern is including so called "niche" crops that have a significant potential for the diversification of the oilseed-and-grain pattern, which dominates in the crop rotations in southern Ukraine.

Keywords: *climate change, greenhouse gases, precipitation, temperature, agricultural sector, low-carbon agriculture, niche cultures.*

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Introduction. The current development of the agrarian sector is based on the concept of sustainable development which covers the economic, environmental and social challenges that society face today. It changes traditional views on agriculture. As the world population is growing, agriculture strengthens its position as the main supplier of resources to provide humanity with food and income in order to improve their living standards. At the same time, agriculture is a significant source of greenhouse gas emission which is a major cause of global climate change. Thus, if the volumes of agrarian production keep increasing, its negative impact on the environment is upscaling. On the other hand, climate change increases the risks of agricultural production. Consequently, the society faces the need to modernize the traditional model of agrarian production, taking into account the global climate change.

Analysis of recent researches and publications. Several authors believe that climate change is a major issue related to global food security. Its effective provision is possible under condition of improvements made to the management of agricultural systems and available natural resources. The future of food security directly depends on natural resources, the state of the environment and climate change [1, p. 12; 2, p. 15; 3, p. 108].

The aim of the articles. The objective of research is to analyse the main aspects of climate change impact on agriculture in Ukraine, to justify measures to minimize its impact on agricultural production and reduce the impact of agriculture on the environment.

Research results. Ensuring food security is possible by creating appropriate conditions to adapt agricultural producers to modern changes. Transformation in the agrarian sector should be done in order to feed the growing population of the planet (according to the World Bank forecasts, by 2050

the population will increase to nine billion, and food production worldwide - by 70-100%), to reduce poverty and to ensure the economic growth without harming the natural resource potential.

The World climate change is happening faster than scientists predicted. At the end of 2015, at the 21st Conference of Parties of the UN Framework Convention on Climate Change, the Paris Climate Agreement [4] was adopted and was signed on behalf of Ukraine in April 2016 in New York [5]. This agreement replaces the Kyoto Protocol to the UN Framework Convention on Climate Change. Assembly of the Paris Summit aimed to study strategies to stabilize greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference into the climate system. Scientific research results show that 2ºC temperature increase on Earth, compared to pre-industrial times, will have dangerous and unpredictable effect on climate (faster melting of glaciers will lead to flooding the coastal towns and small islands, the extinction of many species of animals and other destructive weather events). Since 1850, the average temperature has increased by 1ºC, though the agreed safe limit for global warming is 2ºC. Moreover, the level of CO_2 has grown up by 30% after the Industrial Revolution, since 1979 the ice melt in the Arctic Ocean has increased (by 4% in 10 years), the new century will have 9 of 10 hottest years [6].

Therefore, the aim of the Paris Summit was to develop ways to constrain carbon emissions, enabling countries to continue economic development and provide support to the least developed areas and those most affected by rising temperatures.

Within the framework of the Paris Agreement the global goal of preventing temperature increase of more than 2ºC in comparison to pre-industrial level has been set, aiming to reduce this temperature to 1,5ºC [6].

The main reason for the Agreement ratification in our country is the fact that the issue of greenhouse gas emission reductions for Ukraine is connected to decreasing of the share of fossil fuels, ensuring energy independence, differentiation of energy supply and sustainable development of the country.

However, the fight against climate change requires significant financial resources. Experts estimate that global climate change requires 114 trillion USD, and Ukraine needs more than 100 billion USD. In the autumn of 2017, an attempt was made to find sources of funding at the climate conference of the signatories of the United Nations Framework Convention on Climate Change (COP 23) in Bonn. These issues were discussed, in particular, in the Bonn Zone, which directly concerned the real economy, the public and the financial market. Participants exchanged advances in technologies and financial instruments to reduce emissions, accumulate financial resources [7].

According to the World Economic Forum, the delay of global warming within 2ºC by 2030 costs 114 trillion USD. But according to the Climate Policy Initiative, the world spends over 500 billion USD each year on climate change, that is, the gap between needs and capabilities. It was indicated that the main problem is the lack of a regulatory framework for the functioning of this market segment. The climate deal should be approved by the NDCs (Nationally Determined Contributions) and the mechanism for exchanging certified greenhouse gas (GHG) emission reduction units [7].

Large companies already understand that ignoring climate risks (floods, droughts, etc.) can lead to future losses and they are preparing for a potential increase in the price of greenhouse gas emissions in the future. That is why, due to the lack of a single standard for green projects, they actively use debt-climatic finance and prepare to increase the price of greenhouse gas emissions in the next 3-5 years, for which they actively reduce greenhouse gas emissions, increase energy efficiency and production of electricity from renewable sources. In addition to this, the market for greenhouse gas emissions trading should operate, with fluctuations in prices for allowances, taking into account supply and demand. As a result, countries where emission reductions will be relatively expensive will be able to buy them where emission reductions can be achieved at lower cost.

Ukraine committed to reduce greenhouse gas emissions and build a "green" economy. That is to rebuild its economy, make it energy efficient, switch from using traditional energy resources (coal, gas) to renewable energy sources. It will cost more than 100 billion USD, which is comparable to the country's external public debt. According to the conclusions of the "Zone Bonn" COP23 panel to solve the above mentioned problems both the world and Ukraine should move in the following direction:

- introduction of public-private mechanism of accumulation and distribution of climatic finance as the most effective for solving these problems;
- ensuring the growth of the climate finance market, which requires a universal mechanism for the accumulation of money;
- harmonisation and unification by each country of its own regulatory framework in the field of green finance;
- introduction of common standards for the definition of "green assets" at the international level, which will allow companies to invest in projects or other companies around the world on unified basis [7].

The impact of climate change on agriculture

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (hereafter referred to as the Report) covered current climate change and its causes, expected climate change, risks and impacts, future approaches to adaptation, mitigation and sustainable development at the global level. In this report, it is much more explicit in comparison to the past indicated the uniqueness of the warming and the widespread climate change.

The main conclusion of the report is a proof and evidence of human impact on climate change. Anthropogenic emissions of greenhouse gases caused by economic development and population growth have led to unprecedented levels of atmospheric concentrations of the main greenhouse gases - carbon dioxide, methane and nitrous oxide - in the last 800 years. Consequently, the world needs substantial and sustainable decarbonisation, which, along with adaptation measures, will limit the risks of climate change.

The report provides evidence that climate change is already taking place. Each of the last three decades was warmer than the previous one and warmer than any other starting from the beginning of the observation. By the end of the century the temperature will probably rise for 3,7 to 4,8°C or above.

The report provides pessimistic predictive assessment of food security in the context of climate change. Observations prove its negative impact on crop yields. In particular, in regions with tropical and temperate climate, a temperature increase of 2°C without adaptation to it will negatively affect the yield of wheat, maize, soya, and rice, although it will have positive effects in some regions. A global temperature increase of 4°C with the reduction of renewable sources of water and increased competition for water resources will trigger food security risks globally.

To predict changes in the climate system under assessment report on climate change a set of four scenarios was defined, it's called the Representative Concentration Pathways (RCP). They determine the approximate total amount of radiation exposure[2] in 2100 compared to 1750.

The four RCP scenarios include:

- emission reduction scenario, which is expected to have low climate impact (RCP 2.6);
- stability scenarios (RCP 4.5 and RCP 6.0);
- high GHG scenario (RCP 8.5) [4, p. 29].

The change in global temperature at the end of this century is likely to exceed 1,5°C compared to the period 1850-1900 in all scenarios of RCP, except for RCP 2.6, 2°C in RCP 6.0 and RCP 8.5 scenarios and may exceed 2°C in RCP 4.5 scenarios. Warming will continue after 2100 according to all scenarios of RCP, except for RCP 2.6 [8, p. 19-23].

According to the research conducted on the basis of the scenarios covered in the Report, in the period from 2010 to 2070 the temperature is expected to rise throughout Ukraine: about 1,65°C (Steppe) and 1,74°C (Forest-steppe) for the RCP 4.5 scenario and between 2,68°C (Mixed forests) and 2,98°C (Steppe) for RCP 8.5 scenario [9, p. 21].

[2] Factors influencing climate change are natural and anthropogenic substances and processes that change the energy balance of the Earth. Radiation influence is a quantitative indicator of changes in energy flows caused by the change of these factors by 2011 compared to 1750. The positive value of radiation exposure leads to an increase of surface temperature, and the negative one leads to its decrease.

According to forecasts, climate change will not significantly affect the average rainfall. In the scenario RCP 4.5, the change in rainfall will range from 13 mm in the Steppe zone to 55 mm in the Forest-steppe. Tangible changes will take place in the scenario RCP 8.5 - more than 80 mm in the zone of Mixed forests and less than 13 mm in the zone of Steppe [9, p. 22]. And it is the Steppe area that may have a significant reduction in production by 2070 due to climate change. According to some estimates, wheat output will probably be reduced by 11% for the RCP 4.5 scenario and by 18% for the RCP 8.5 scenario [9, p. 26].

In addition, within the framework of the University of Notre Dame project, an assessment of the Global Adaptation Index (ND-GAIN) [10] is being made, which forms the world ranking of vulnerability to climate change, given countries' readiness to improve their resilience to climate change.

According to the University of Notre Dame, in the world ranking Ukraine is the 62th among 180 countries and it has the index ND-GAIN of 57,6 (New Zealand has the highest – 81,9, and Eritrea has the lowest – 24,9). This index is calculated on the basis of the vulnerability index and the readiness index to improve stability. The vulnerability index for Ukraine in the last period is improving: in the last few years it has decreased from 0,339 to 0,328. It identifies overall vulnerability by assessing the following components: food, water resources, health, ecosystem services, human habitat, as well as infrastructure. The worst scores in Ukraine were the following: the intensity of agriculture, the water level, the capacity of the dams. The readiness to improve the sustainability index (taking into account three components - economic readiness, readiness of management and social readiness) in the last period deteriorated from 0,511 to 0,480, primarily due to the indicator characterizing political stability and the level of non-violence, as well as the level of innovation development.

Thus, according to all estimates, Ukraine is not among the most vulnerable to the global warming regions on our planet, although the effects of climate change are becoming increasingly tangible for its territory. According to the data of the Ukrainian Hydrometeorological Center for the last 20 years, the average annual temperature in the summer has increased by 0,8°C in comparison to the climatic norm (1961-1990), and the average winter temperature has risen by almost 2°C. Mountain regions are characterised by slightly lower average annual air temperature growth: 0,7°C in the Ukrainian Carpathians and 0,3°C - in the Crimean Mountains. Such temperature changes influenced the rhythm of seasonal phenomena, the frequency and force of extreme weather conditions (abnormal heat in 2006, 2008, 2010, 2012, 2014, 2015, record snowfalls in the west and central part of the country in March 2013, etc.).

In the last years of this century, in each period there were local droughts in the south and south-east, in the central and eastern part of the Forest-steppe zone and throughout the Steppe zone. The severe droughts that took place in 2007 and 2009 were accompanied by a sharp deficiency of rainfall and covered significant territory of Ukraine (especially in May-June 2007 and July-August 2009) [11; 12, p. 3-5].

Now there is no extreme climatic situation in Ukraine's agriculture. However, rising air temperature and uneven distribution of rainfall which has a storm, local character in the warm period and do not provide an effective accumulation of moisture in the soil, led to an increase in the number and intensity of arid phenomena. In combination with other anthropogenic factors, this may lead to an expansion of the risk-taking zone and even to the desertification of some areas of the southern regions of Ukraine. The repetition of droughts in different agro-climatic zones is 20-40%. Over the past 20 years, the recurrence of droughts has almost doubled. There is a dangerous tendency to increase the repetition of arid conditions in the zone of sufficient atmospheric humidification, covering Polissya and northern areas of the Forest-steppe [13, p. 9-12; 14].

According to T. Adamenko, there is a high probability that global warming will lead to deterioration of climatic conditions for 2 million hectares of land. With the current warming and unchanged rainfall, part of the territory of Ukraine may become unfit for agriculture in 10-15 years (part of Zaporizhzhya, Kherson, Mykolayiv and Odesa oblasts) [15].

In the next decade, climate change will have both positive and negative consequences for agriculture, which will differ, first of all, in agro-climatic zones. Extending the growing season will be favorable for farmers of Polissya area and in southern regions may lead to increased drought.

The results of research carried out at the Ukrainian Hydrometeorological Center in relation to the cultivation of the main grain crops (winter wheat and corn) using climate scenarios allowed to quantify the reaction of crops to the change of agro-climatic conditions of cultivation.

In particular, the next 10-20 years will be favorable for the production of winter wheat due to the possible shift of sowing terms for 20-40 days and more efficient use of the conditions of autumn vegetation, which can lead to an increase in total productivity of crops by 20-40%. According to these scenarios, in a 25-year period in the northern regions producers will sow sunflower and corn on the grain of more productive middle and late varieties. For early spring crops (spring barley, spring wheat, oats) raising the temperature background will cause a drop in their yields due to a decrease in the growing season and earlier maturation.

Climate change will also have a significant impact on the cultivation of vegetables - the border of the Steppe will significantly advance to the north, being in the current Forest-steppe zone. As a result, the northern limit of production of eggplants, sweet peppers and tomatoes will shift to the north, where these crops will be provided with heat. At the same time, there is a risk of reducing areas favorable for growing potatoes, cabbage and cucumbers [16]. One of the ways to adapt vegetable crops to the growth of temperature is pre-sowing hardening against drought, grain cultivation and seeds with salt. For example, potatoes become more durable to drought, when before landing to warm it to 35-38°C [17].

Climate change in Ukraine in the direction of warming will also contribute to the formation of favourable conditions for the intensive development of dairy cattle breeding and breeding of pigs in the western Polissya and right-bank forest steppe, meat cattle breeding in the Steppe and western regions of the Polissya [18, p. 203].

Vulnerability assessment of population and climate change adaptation should be a key component of agricultural policy. Such adaptation measures as preserving water resources in the soil (i.e., no-till), the introduction of drought tolerant varieties of agricultural crops and the development of irrigation are crucial for increasing resistance to climate change and food security, especially in the South [19, p. 9].

For agriculture, warming will have both positive and negative effects. The following should be considered as positive: improving conditions and reducing the harvest time; the possibility of effective introduction of late varieties (hybrids) using increased temperature resources; improving conditions of winter crops and perennial grasses; increasing fertilizer efficiency. The negative consequences include: increasing the amount of carbon dioxide will have positive effect on the yield of crops but it will cause grain quality deterioration; increasing repeatability and severity of droughts during the growing season; accelerating the decomposition of humus in soils; soil moisture deterioration in the southern regions; lack of full vernalisation of grain; increasing the number of pests, the spread of pathogens of plant diseases and weeds due to favourable conditions for their wintering; increasing wind and water erosion of the soil caused by an increase in the number of droughts and extreme rainfall; increasing risk of winter crops freezing due to the lack of stable snow cover with a significant decrease in temperature.

Weather conditions of recent years have shown the necessity of crops adaptation to global warming conditions, as the cultivating crops profitability to a large extent depends on this.

The impact of agriculture on climate change

The problem of food security and its ecological component have been recognised as one of the top priorities of the 21st century. The question of increasing food production should be solved taking into account the natural-resource component, which will reduce the negative environmental impact. In the context of global climate change, agriculture, as a determining factor in ensuring food security, faces two interrelated challenges: the modernisation of existing production technologies to counteract the negative effects of climate on production; having modernised the technologies ensure the increase of production that minimize greenhouse gas emissions.

Agriculture is a significant source of greenhouse gas emissions. The intensification of the industry and the introduction of new technologies contribute to its growth. At the same time, the main

greenhouse gases are methane (CH_4) and nitrous oxide (N_2O), having 21 and 310 times, respectively, greater potential for global warming compared with CO_2 [20, p. 26]. The share of world agriculture is about 10-12% of the total volume of anthropogenic emissions of greenhouse gases, which is dominated by emissions of nitrogen oxides from soil and methane from intestinal fermentation.

The constant growth of crop production without introducing measures of rational land use leads to a reduction of carbon stocks in mineral soils and an increase in its emissions from land cultivation. Growth in livestock production also causes an increase in greenhouse gas emissions (Table 1). Thus, the development of low-carbon agriculture should become a priority in terms of increasing production volumes [21, p. 24-25].

Low-carbon development is a country strategy that combines climate change and national economic development priorities. In Ukraine, there was a need for a transition to a sustainable low-carbon development model, which would reduce the magnitude of the negative impact on the environment by reducing emissions and increase the competitiveness of products by reducing the dependence on carbon stock and its share in the cost of the final product [22, p. 23-28].

Livestock breeding is one of the most important factors in the formation of food security of the country, which provides the population with food, promotes optimal use of food waste and plant residues after harvest, and provides crop production with environmentally friendly organic fertilisers. However, it is the main source of greenhouse gas emissions - methane (CH_4) and nitric oxide-1 (N_2O) [23].

Table 1. Structure of pollutants emissions in terms of production and technological processes in agriculture and forestry,%

Indicators	2012	2013	2014	2015
Agriculture and forestry, land use and forest biomass change	**100,0**	**100,0**	**100,0**	**100,0**
Cultivation of agricultural crops using fertilisers (except manure)	0,3	0,3	0,3	0,6
Cultivation of agricultural crops without fertilisers	0,01	0,4	0,4	0,4
Enteral (intestinal) fermentation	65,4	55,4	53,6	54,0
Cleaning, storage and use of manure and organic compounds	32,2	41,2	43,2	42,5
Use of pesticides and limestone	0,0	0,0	0,0	0,1
Cleaning, storage and use of manure and nitrogen compounds	2,0	2,7	2,5	2,4

Source: Calculated by the authors according to the State Statistics Service of Ukraine data for several years.

Another reason for the increase in carbon emissions from agricultural land is the overall deterioration of the balance and the decrease of humus in soils and the rate of its mineralisation to meet the needs of plants in nutrients.

Humus is the most valuable organic and biologically active component of the soil. A century ago the Ukrainian soil contained an average of 4-6% of humus, but now it is 3,2%. It should be noted that when the soil contains less than 2,5% of humus – it is not black soil. According to the materials of agrochemical certification of agricultural land, which is carried by branches of the Institute of Soil Protection of Ukraine, it is defined that every 5 years our soils lose an average of 0,05% of humus. In monetary terms, during twenty years, this amounts to about 450 billion hryvnia (UAH). To maintain a proper balance of humus in the soil it is necessary to fertilise 1 hectare of cultivated area with about 8-10 tons of organic fertilizer annually. Each year, the soil loses about 400-500 kg of organic elements per hectare and unfortunately it is not possible to replenish this loss. 100 years needed to get 1% of humus [24, p. 12].

The restoration and preservation of humus and soil fertility contribute to reducing carbon emissions from land cultivation, which requires the application of scientifically based agrotechnologies, where the fertiliser is the main component. Unfortunately, in the last few decades, due to the reduction in livestock population, there is a decrease in the volumes of organic fertilizers (in

1990 – 257,1 million tons, 2000 – 28,4, in 2014 – 9,9 million tons) [25, p. 147]. The growth of volumes of crop production and the intensity of exploitation of agricultural land leads not only to an increase in carbon emissions, but also to the loss of nutrients and minerals, which results in decreasing the fertility of soils.

In conditions of manure deficiency, using post-harvest corn crops accelerates the infiltration of moisture into the soil, weakens erosion, absorbs residual undersized nitrogen for harvesting and it is 2-3 times more efficient than manure[3]. Crushed post-harvest corn crops remaining in the surface layer of soil and on its surface take on (quench) the kinetic energy of rain drops, preventing soiling and formation of the surface crust, weaken erosion and absorb the residual undersized nitrogen, thereby preventing harvest loss and contamination of groundwater. Moreover while decaying it improves the harvest of the next cultivated culture [26, p. 9-10].

Sapropel is an alternative source of organic fertilisers, along with sowing fertilizers, post-harvest residues, various types of compost, etc. [27, p. 28-35]. Using 30 tons of sapropel fertilizer per hectare in Polissya and Forest-steppe contributes to the formation of an average of 1,3 tons per 1 ha of humus, in case of increasing fertiliser usage to 60 tons per 1 ha, the formation of humus increases to 2.6 t / ha. Due to this, not only the fertility and moisture-retaining capacity of the soil, but also the productivity of all groups of crops increases [28, p. 235-237].

Increasing the area under perennial grasses reduces carbon emissions by 17%. In addition to the use of new soil cultivation technologies, crop rotation as an effective measure to conserve carbon stock in the soil is an important component, which increases the yield of arable land by 25-30%. The above mentioned measures will promote low-carbon development of the agrarian sector.

The use of new breeding varieties in crop production is also positive for storing carbon stocks in a soil reservoir. Adapted to specific natural and climatic conditions, varieties of agricultural crops allow to obtain high yields at a lower level of mineralization of soils [28, p. 239].

In agriculture, the most cost-effective options for mitigating the impact of climate change are the rational use of arable land and pastures, as well as the restoration of organic soils.

Niche crops in the context of climate change

Within the conditions of climate change, scientifically grounded formation of agricultural crop area is an important factor in improving the efficiency of agriculture, taking into account climate change, adaptation of crop production to these changes, which will result in the most effective use of natural resources in the new climatic conditions.

One of important measures to improve the crop rotation structure is to include niche crops that have significant potential for diversification of the monocultural oilseed and grain trend, dominant in the crop rotation of the south of Ukraine. The main niche cultures are oats, rye, buckwheat, flax, mustard, camelina, peas, beans, sorghum, etc.

So far, there is no consensus among the experts on which crops to be considered as niche ones – some researches include crops that require further deep processing and are used in related industries such as pharmaceutical, confectionery, textile (flax, hemp, thistle, camelina, mustard). Others include crops and oilseeds, the volume of production of which is several times smaller than the main crops.

Niche cultures can be used as replacement for fallen grains or oilseeds. For example, buckwheat is one of the latest (by the time of sowing) spring crops, it is widely used as a replacement for dead winter crops. Flax is also suitable for this. To reduce losses caused by drought, some market participants replace traditional crops and oilseeds with a drought-tolerant sorghum.

However, these crops cannot become widespread, as they have a limited demand and will be highly marginal only if they maintain in their niche. However, they are an effective tool for regulating crop rotation, and in the face of lower world prices for major agricultural crops, especially maize and wheat, they may be of interest to producers [29].

Oats is considered as a niche culture; its cultivation does not require favourable climatic conditions, because it is unpretentious to temperatures and has the ability to adapt to different types of

[3] 3-4 tons of straw is equivalent to 9 tons of manure per hectare.

soils. Oats is used in the production of agro-food products and as feed for livestock, due to the content of a significant amount of nutrients.

Rye is one of the few crops that can be grown on scarce land, it is resistant to drought and frosts. Today, the seed market presents a large variety of high-yielding hybrids of rye, which are well adapted to sandy soils with low moisture content. Rye grain is a raw material for the baking industry, green mass is used for cattle fattening.

Buckwheat is a valuable cereal crop grown on black and degraded soils characterized by high aeration, moisture and waterproof. It is grown without chemical fertilizers and pesticides, because it is not afraid of weeds, as it can 'displace' them from the field. The culture is used both as post-harvest crops and as green manure for fertilization. Buckwheat is a good predecessor in crop rotation for other crops, especially when growing it in a wide variety of ways. Cultures grown in crop rotation after buckwheat are well fed with phosphorus and potassium due to its post-harvest residues. Buckwheat is a valuable honey culture because in favorable weather conditions, 1 hectare of it can provide 90-100 kg of high-quality medical honey [30].

In the south of Ukraine, mustard is an oilseed crop alternative to sunflower and rape, which can restore the optimal ratio of crops in crop rotation and provide a stable income to producers. Mustard improves phyto-sanitary state of the field, acts as an effective green manure and a good precursor for grain crops (as it suppresses growth of diseases). Seeds are used for the manufacture of mustard oil, powder for the production of sauces and medicines. Mustard seeds are almost entirely export-oriented products that are in demand in the European market, especially in Germany [31].

Oilseed flax is a crop, alternative to glabrata rape in crop rotation which may partly replace sunflower in the structure of consumption. It can be grown in different regions of Ukraine; it is income equivalent to other oilseeds. The advantages of oilseed flax are, firstly, its drought tolerance, and secondly, a short growing season that allows flax to be collected at the end of July, making it one of the best precursors for winter crops. Thirdly, resistance to adverse weather and climatic conditions, in particular, sprouting is resistant to spring frosts, and the culture itself - to the spillage of seeds and sinking. It is possible to seed up to 30% of sown area by flax, but the market of oilseed flax remains niche (0,2% of all crops) and has a small segment in the production of oilseeds (0,8% of crops of oilseeds) in Ukraine [31].

Camelina is a culture that belongs to the rape family and is grown as an accompanying crop with beans. Camelina oil is similar to linseed oil for high content of linoleic and linolenic fatty acids (Omega-3 and Omega-6). Camelina is rarely grown in Ukraine today, except for domestic needs. In 2015, only 71,2 hectares of this crop were sown in the country. Almost all of them were in the Sumy region.

Table 2. Dynamics of the collected area under niche crops, thousand hectares

Agricultural crops	1961*	1990	2000	2010	2014	2015
Rye	1723,1	517,2	638,1	279,1	185,1	150,8
Oats	706,4	485,9	481,0	310,8	243,6	210,5
Buckwheat	394,8	362,3	528,9	198,6	136,7	127,7
Oilseed flax	36,2	3,9	2,2	56,3	33,4	62,1
Mustard	2,2	1,6	19,6	106,4	96,3	58,8
Camelina	6,4	1,2	3,7	0,9	0,3	0,1
Peas	725,2	1270,8	285,2	278,5	153,5	168,7
Beans	8,8	23,5	33,2	22,6	28,7	35,5
Sorghum	12,2	24,9	14,4	28,7	83,1	50,6

**Sown area.*

Source: Calculated by the authors according to the State Statistics Service of Ukraine data for several years.

As noted above, cultures may lose their niche as a result of popularization at the same time reducing marginality and vice versa. During the last fifty years out of all crops listed in Table 2, rye and peas have become niche out of widespread crops, but other crops haven't lost their niche, having

changed in 2-25 times in the area. Although their marginality, for example, buckwheat, is constantly changing due to market demand and the area under them changes accordingly.

Conclusion

1. According to the Intergovernmental Panel on Climate Change, Ukraine is not among the most vulnerable to the global warming regions of our planet. However, the changes that will be observed on its territory during current century will be substantial and will affect all areas of human life and the state of the environment. Unless appropriate immediate measures are taken, climate change will continue to exert pressure on agricultural ecosystems, and this will particularly affect the most vulnerable regions and populations.

2. One of the most serious problems of the impact of climate change on agricultural production will be the change in the length of the growing season of agricultural crops. An increase in its duration will be effective for the agriculture of the northern part of Ukraine, whereas in the southern regions, due to an increase in the average annual temperature of 1-2°C, arid phenomena can increase significantly. Taking into account the rising temperatures and virtually unchanged rainfall before 2030, the southern part of the country may become unfit for agriculture.

3. In order to minimize the impact of climate change on agricultural production, the focus should be on the following adaptation measures: development of agricultural systems with increased soil protection and moisture-saving qualities, the use of resource-saving technologies and mechanisms; the use of varieties of agricultural crops with a short vegetative period, resistant to diseases, pests and droughts, fluctuations in weather and zonal specialization; carrying out measures to preserve the soil fertility, protect them from processes of water and wind erosion, salinization, flooding and other degradation processes; development and implementation of integrated plant protection systems from pests, weeds, frosts, drywall, etc.; development and implementation of energy, water and resource-saving technologies for integrated land reclamation, restoration and expansion of irrigation in accordance with predicted climate change; creation and improvement of mechanisms of functioning of insurance, seed, feed and food funds as a basis for minimizing losses from natural phenomena; development and implementation of insurance policies against adverse natural conditions.

4. To reduce the negative impact of agriculture on the environment, namely to ensure minimization of greenhouse gas emissions, it is necessary to ensure: optimization of the timing of sowing and the selection of varieties of agricultural crops; displacement of climatic zones of cultivation of crops; improvement of technologies for cultivating land and pastures for the purpose of conservation and accumulation of carbon in the soil; cultivating energy crops to replace non-renewable fuels; restoration of degraded soils; modernization of collection systems, storage of manure to reduce emissions of CH_4 and NH_3; modernization and implementation of optimal systems for keeping and fattening farm animals; the introduction of technologies for the introduction of nitrogen fertilizers that reduce the emission of N_2O.

Summarizing the above, it can be stated that measures aimed at reducing greenhouse gas emissions are close in their content to measures for adapting agriculture to climate change and promoting the formation of ecological agriculture.

REFERENCES

1. Nechyporenko, O. M. (2016). Status and prospects of the Ukrainian economy's agricultural sector adaptation to global climate changes. *Ekonomist*, 11, 10-14 [in Ukrainian].
2. Panasyuk, B. Ya. (2015). Global climate change and the economy. *EkonomikaAPK*, 11, 14-22 [in Ukrainian].
3. Udova, L. Prokopenko, K. Didkovska, L. (2014) Impact of climate change on the development of agricultural production. *Ekonomìka ì prognozuvannâ*, 3, 107-120 [in Ukrainian].
4. Paris Agreement. Retrieved from: http://www.zakon0.rada.gov.ua/laws/show/995_l61/page [in Ukrainian].

5. The Law of Ukraine "On ratification of the Paris agreement". Retrieved from http://www.zakon3.rada.gov.ua/laws/show/1469-19 [in Ukrainian].
6. Met, MakHrat (2016). Klimatychnyi samit: shcho tse take I komu tse potribno. Retrieved from http://www.bbc.com/ukrainian/science/2015/11/151130_climate_summit_ko [in Ukrainian].
7. Financial responses for Ukraine and the world at the Climate Conference in Bonn. Retrieved from https:// www.energo.delo.ua/energo-inter-experience/finansovi-vidpovidi-dlja-ukrajini-j-svitu-z-klimatichnoji-konfer-337186/?supdated_new=1512561578 [in Ukrainian].
8. Climate Change 2013 (2013): The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F. Qin, D. Plattner, G.-K. Tignor, M. Allen, S.K. Boschung, J. Nauels, A. Xia, Y. Bex, V. and Midgley, P.M. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA [in English].
9. Müller, D. Jungandreas, A. Koch, F. Schierhorn, F.(2016) Impact of Climate Change on Wheat Production in Ukraine. Kyiv: Institute for Economic Research and Policy Consulting [in English].
10. Notre Dame Global Adaptation Index (2014). Retrieved from http://www.index.gain.org [in English].
11. Lialko, V. I. Yelistratova, L. O. Apostolov, O. A. (2014). Researches of problems of dryness in the territory of Ukraine with use of land and satellite information. *Ukrainen journal of remote sensing*, 2, 18–28 [in Ukrainian].
12. Adamenko, T.I. (2014). Agro-climatic zoning of the territory of Ukraine taking into account the climate change. Bila Tserkva: TOV "RIA" BLITS [in Ukrainian].
13. Adaptation in climate change (2015). Uzhgorod: Karpattskyi instytut rosvytku [in Ukrainian].
14. Meteorologists are concerned about the dangerous trend growth droughts in Ukraine (2015). Retrieved from https://www.ukrinform.ua/rubric-presshall/1912344-vpliv-zmin-klimatu-na-vodozabezpechennya-vodospojivannya-i-prodovolchu-bezpeku-zala-1.html [in Ukrainian].
15. Global warming will make unsuitable 2 million hectares of Ukrainian lands in 10 years – meteorologist (2015). Retrieved from: http://ru.golos.ua/ekonomika/globalnoe_poteplenie_sdelaet_neprigodnyim_2_mln_gektarov_ukrainskoy_zemli_uje_cherez [in Russian].
16. Adamenko, T.I. (2016). Do not panic: climate change may prove useful for agriculture. Retrieved from http:// tyzhden.ua/Society/55863 [in Ukrainian].
17. Chief agro-meteorologist Ukraine: After 20 years, the south of the country could become a desert (2016). Retrieved from: http://www.economics.unian.net/agro/1165246-glavnyiy-agrometeorolog-ukrainyi-cherez-20-let-yug-stranyi-mojet-prevratitsya-v-pustyinyu.html [in Russian].
18. The Fifth National Communication on Climate Change (2009). Kyiv [in Ukrainian].
19. Ukraine: Soil fertility to strengthen climate resilience. Preliminary assessment of the potential benefits of conservation agriculture (2014). FAO/World Bank Cooperative Programme. – Rome [in English].
20. Norse, D. (2012). Low carbon agriculture: Objectives and Policy pathways. *Environmental Development*, Issue 1, 25–39. [in English].
21. Summary for Policymakers. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2014) [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA [in English].
22. Haidutskyi, I. P. (2016). Priorities for sustainable low-carbondevelopment in Ukraine. *Ekonomika ta derzhava*, 9, 23-28 [in Ukrainian].
23. Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998). Retrieved from http://unfccc.int/resource/docs/convkp/kprus.pdf [in Russian].
24. Datsko, L. (2016). No value, and spare. *Expres*, 24 (8603), 12 [in Ukrainian].
25. Statistical Yearbook 2014 (2015). Kyiv: State Statistics Service of Ukraine [in Ukrainian].

26. Saiko, V. F. (2008). Agriculture in the context of climate change. *Proceedings of the National Scientific Center "Institute of Agriculture UAAS"*. Kyiv: VD "EKMO" [in Ukrainian].
27. Shevchuk, M.Y. (1996). Ozerni sapropeli Ukrainy: zbirnyk tekhnologii I rekomendatsii shchodo vykorystannia sapropeliv u tomu chysli na zabrudnenykh radionuklidamy zemliakh, normatyvnykh aktiv, dovidkovykh materialiv. Lutsk: YAAN [in Ukrainian].
28. Butrym, O. V. (2014). Otsinka potentsialu nyzkovuhletsevoho rozvytku roslynnytstva Ukrainy. Visnyk ZHNAEU. Ekonomika prurodokorystuvannia ta ekolohichnyi menedzhment, № 1-2 (43), t. 2 [in Ukrainian].
29. Klimat, kon'yunktura I ekonomicheskaya nestabil'noct' vynuzhdayut agrariev osvaivat' proizvodctvo nishevykh kul'tur (2015). Retrieved from http://www.business.ua/companies/polevaya_nish-284919/ [in Russian].
30. Rynok hrechky: stabilizatsiia vyrobnytstva ta spozhyvannia (2016) Retrieved from http://www.agro-business.com.ua/ekonomichnyi-gektar/1077-rynok-grechky-stabilizatsiia-vyrobnytstva-ta-spozhyvannia.html [in Ukrainian].
31. Plany na vesnu: 5 nishevikh idey v rastenievodstve (2016) Retrieved from http://www.agroportal.ua/publishing/lichnyi-vzglyad/5-nishevykh-idei-v-rastenievodstve [in Russian].

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PIG BREEDING IN UKRAINE: CURRENT STATE AND PROBLEM SOLVING

KHAKHULA BOGDAN, ***a postgraduate student,***
Bila Tserkva national agrarian university

SVYNOUS IVAN., ***Doctor of Economics, professor,***
Bila Tserkva national agrarian university
e-mail: bogdan.khakhula@gmail.com

Abstract. *The article deals with the issues of pig breeding production development in Ukraine as the basis for efficient and competitive functioning of commercial pig breeding.*

According to the study results, agricultural production reformation as well as changes in ownership patterns and other causes contributed to significant losses in swine industry, which also negatively affected the efficiency of breeding farms - breeding stock-rearing farms - and, in particular, the nucleus.

It has been established that a significant factor that caused the decline in pig breeding is the fact that most large-scale farms of the industry are oriented to purchase breeding stock of foreign selection.

It is proved that our state needs to change a number of aspects, ranging from the legislation to functions division (between the state and producers), in order to reach the world level with its own pedigree stock.

The priority directions of scientific support for the development of breeding and breeding work should be: conducting (realization) purposeful veterinary-protective activity, in particular developing the requirements to biosafety and the Ukrainian identification system that will be able to control swine breeding; development and improvement technology of breeding, industrial and small-scale growing and feeding of animals; amplification of pig breeding base by creating new meat production farms; improvement of pig breeds by using the world's best genetic resources, optimizing the variety of animals' breed of based on the best domestic and foreign breeds; providing productivity test with piglet; creation of new allowance and feeding technologies.

Key words*: pig breeding, export, import, Ukrainian pig breeders association.*
JEL: Q10, Q18, L52
UDC: 338.43 (477)

Introduction

A balanced development of the pig products market can be ensured under the condition of comprehensive modernization of pigs breeding. The world experience proves the significance of the industry breeding base and the effective use of animals genetic characteristics for modern pig breeding, that should make the basis for developing a system of complex biological resources regulation. Organization of the system of breeding in pigs farming is based on the use of modern breeding methods and takes into account a number of key indicators that will make it possible to control the population genetic parameters, to assess the genetic potential of the lines, breeds or individual populations of animals and to determine the influence of various factors on the breeding efficiency. An adequate functioning of this system starts with the balance of the of pedigree products market, which will promote the increase of genetic potential, preservation and improvement of valuable breeds gene pool.

The issue of livestock market functioning, in particular pigs farming, is highlighted in the papers of I. Balanyuk, P. Berezivsky, R. Grabovsky, S. Dusanovsky, O. Mazurenko, V. Mesel-Veselyak, V. Mykytyuk, T. Mostenska, I. Yatskiv and other scientists.

The results of the conducted research indicate that the share of live pigs in pig production exceeds 30%. Therefore, the ways to increase pig farming competitiveness need grounding, and their development is based on resource-saving technologies and the use of innovative breeding developments, which enables commodity producers to reduce production costs and increase the economic efficiency of production significantly. The economic effect of selection is manifested in increasing the proceeds from the sale of additional production produced during the implementation of the appropriate breeding programs [1].

The organization of breeding work in pig farming involves the identification of the best animal in the herd, their further intensive and purposeful use for the improvement and consolidation of

valuable breeding efficiency in the offspring. Breeding farms can reduce the cost price and increase pork production through using the selection effect in the process of existing breeds improve as well as through creating new high-yielding breed groups, intra-breed types, lines and families [2].

Research Methodology

The experience of the efficient pig breeding industry development in Western Europe, as well as in America (USA, Canada, Brazil), proves that a reliable breeding base with intensive breeding aimed at pig yield and the meat quality improvement is one of the factors of the industry development provision. These countries introduce the latest methods of the animals breeding and productive qualities assessment into the breeding process, including DNA technologies, as well as innovative approaches to feeding and keeping pigs, which enables them to meet the growing needs of the population in meat products (the population in the leading countries consume 100 kg of meat and more *per capita*, including about 40% of pork) and form their export potential [3].

Pig industry organization in the abovementioned countries is worth noticing in the domestic practice. Indeed, nucleus (stuff farm) herds are a structural part of large national and transnational companies, which use rationally the breeding products primarily within the limits of a firm for a three-stage system: the nucleus herd (the nucleus form); a crossbred reproducer (ancestral form) and commercial herds (parent form). Mixed fodder factories and pork processing plants work in the structure of such firms and they form a complete agro-food chain in pig breeding with transparent and regulated relations among all its participants.

It is also necessary to consider the system for organizing pigs assessment for their phenotype and genotype used in foreign pig breeding. Thus, artificial insemination method has been fully implemented in each of the herd categories in Denmark, which contributes to maximizing the use of the best boars, evaluated for the phenotype and genotype, in the conditions of the test station. All the information on the pigs assessment obtained in the conditions of the nucleus herds (breeding stock for reproductive qualities) and the test station (fattening and meat quality) entered the electronic data bank of the Dan-Brad Company, that calculates the corresponding indices (BLUP method), which are transmitted to nucleus herds for practical use. This approach to running the breeding programs in Denmark contributes to the fact that nearly 80% of high-quality pork, as well as breeding pigs, is exported to other countries including Ukraine [4].

Currently, 11 breeds of pigs are bred in Ukraine, among which the largest (90% of the livestock) are Large White, Poltava Pork breed and Ukrainian Pork meat. However, the non-compliance with the requirements on the technology of pigs farming, especially as regards the sow preparation to the farrowing, causes significant losses of young livestock and, results in imperfect use of potential opportunities for the commodity offer formation in the pig products market [5].

Violation of the production-technological chain caused changes in the existing system of introducing young breeding animals breeder' stock in commercial farms and complexes from the breeding plant and the reproducer to the farm and the which resulted in a significant reduction in the use of genetic potential. As a result, there was a need for animals of different breeds and hybrids import. This situation in domestic pigs breeding is conditioned, on the one hand, by organizational and economic factors, and on the other hand, by lagging of the breeding base on the basic productivity parameters due to the imperfect organization of the livestock breeding, the unconsidered approach to improving the genetic potential and obtaining new breeding achievements.

Effective management of breeding work in livestock based on the good interaction of all structural elements of the breeding scheme is one of the main conditions for pig market stable functioning. Organizations that coordinate, serve, and are directly engaged in the reproduction of breeding genetic resources must be identified with indicating their functions and working principles. Currently, the breeding service in Ukraine operates on two levels, namely state and production ones. Organizations and departments that are subordinated to various authorities and financed from the budgets of all levels are the state structures.

At the national level, the Department of the Ministry of Agrarian Policy and Food of Ukraine is the central body of state management in the field of livestock breeding. It controls partially the state

of livestock breeding, coordinates the actions of all services and breeding farms. In addition, the Department is to consolidate the work of associations and other livestock breeding institutions that function at the national level (Fig. 1).

It is established that the current state management of the livestock breeding is in a critical condition, due to a number of bureaucratic restrictions, constant staff reduction of civil servants and unsatisfactory financing. All these do not provide the opportunity to set up sterling units for livestock breeding in state bodies which fulfill all functions provided by legislative documents. In this regard, some of these powers were transferred to state unitary livestock breeding enterprises, which are widely represented in the regions of the country.

In addition, too small amounts of financial support for research institutes of the National Academy of Agrarian Sciences of Ukraine make it impossible to conduct scientific research on the genotypes and breeds of pigs in Ukraine. As is known, genetic breeding centers, which function as a separate structural subdivision of specialized research institutes, also have a low level of technical and financial support and, in fact, have been inefficient for 3-4 years. The main coordination centre for livestock breeding is the National Association for Livestock Breeding "Ukrplemob'yednannya", which is currently in the liquidation stage. Thus, the activity of the national vertical organizational structure is suspended, while it must provide high-quality breeding material to agricultural enterprises and households - producers of pig products - and to monitor the quality of breeding products and the compliance with the requirements of the functioning of breeding plants and breeding reproducers.

The Ukrainian Association of Pig Breeders performs only an advisory function in terms of providing pedigree product to agricultural enterprises, which are only members of this professional association. As noted above, the Ministry of Agrarian Policy and Food of Ukraine carries out only administrative supervision of pig breeders activity. In 2015, these functions were performed only partially, and since early 2016, the breeding enterprises of the corporate sector do not report on the established statistical forms of the industry reporting (Fig. 1).

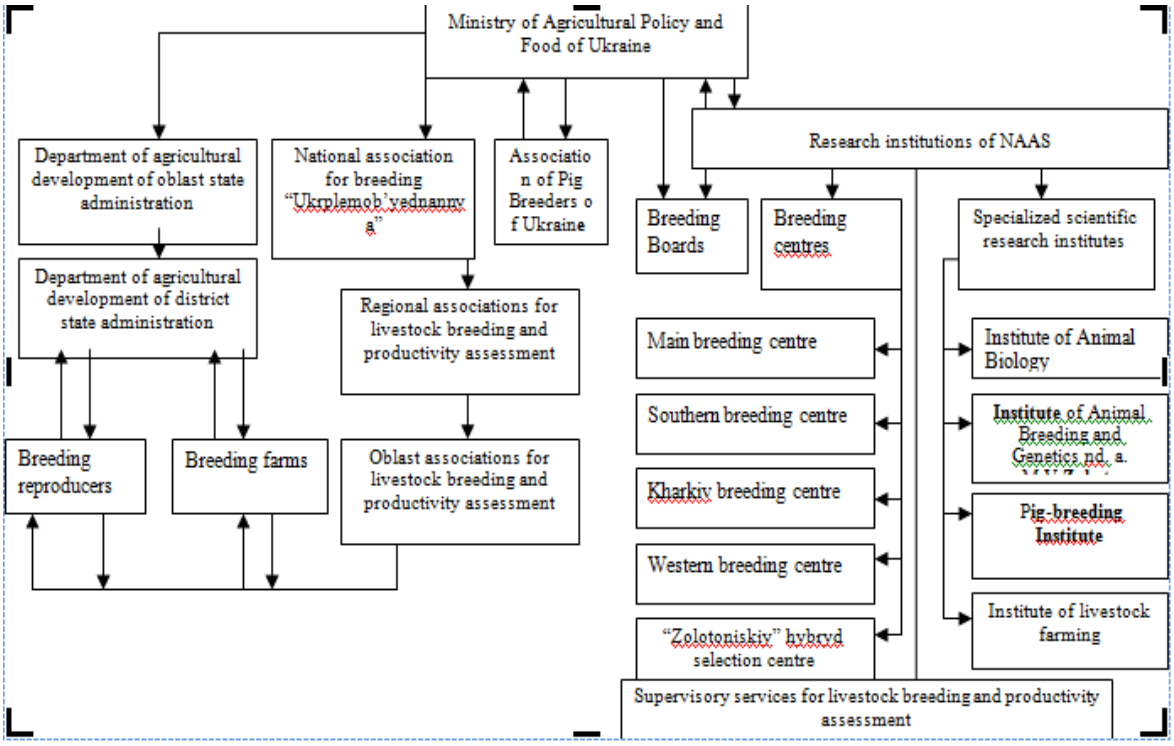

Figure 1. The reprting scheme of breeding industry
Source: developed by the authors

Yet, the program "State support of the livestock sector", which provides partial reimbursement of the pedigree animals cost, has a positive effect on the development of pig breeding. Thus, 50%

(2400 UAH per animal) reimbursement of the cost of animals was paid on an irrevocable basis to the business entities for the purchase of animals bought from October 2014 to October 2015, including pedigree male and female of domestic origin ("elite" class) of Myrhorod, Large Black, Ukrainian Spotted Steppe and Ukrainian White Steppe, Ukrainian Meat, Red White-Rumped breeds from breeding farms plants and breeding reproducers.

According to the 2016 passport of the CPCE 2801540 "State support of the livestock sector" budget program, approved by the order of the Ministry of Agrarian Policy and Food of Ukraine and the Ministry of Finance of Ukraine dated March 4, 2016, No. 80/319, the general fund is expected to pay 50 million UAH. In accordance with this program, the cost (up to 50%) of purchased heifers, cows of domestic origin and pedigree heifers, dairy cows, meat and dairy, meat cows, pedigree male and female pigs ("elite" class) , pedigree sheep breed, rams, young ewes will be partially reimbursed on irrecoverable basis to the enterprises for the animals purchased during October, 2015 - October 2016.

Organization of effective work of the breeding service on the industrial level has become rather important nowadays. The use of selected and improved genotypes taking into account the breeding value of pigs of intensive breeds and types, the use of the best breed types and lines in production, as well as the selection process orientation to animals stress resistance and their resistance to diseases is a characteristic feature of the modern stage of development of the selection process in pig breeding. Also, an active work on the development of comprehensive methods for intensifying and assessment of the breeding value of pigs for reproductive, fattening and meat qualities is carried out. However, the systematic importation of a significant number of pedigree animals into commodity farms can not provide the desired increase or maintenance of the necessary level of pigs productivity without a well-established system of best animals selection and on-site high productivity results consolidation.

At the same time, due to the devaluation of the national currency and the tense epizootic situation in a number of countries, pedigree animals import from European genetic companies has been suspended. The experience of using foreign selection pigs reveal some problems in the imported breeds, since an important requirement of animal breeding - separate production use - is violated in the production conditions. Also, improper farming and feeding conditions affect negatively animal productivity, resource intensity and economic industry efficiency.

In addition, foreign breeding companies do not always sell their best genetic resources or impose restrictions on their use in contracts, which significantly reduces the possibility of productive selection and affects adversely the development of the breeding industry. In this regard, the need to invest significant financial resources, high competition in the global market for genetic resources and the availability of foreign breeding material for pigs are obstacles to the domestic breeding base development. It is obvious that the violation of the state vertical in the control and coordination of state livestock breeding institutions, insufficient financing for research and state selection centers, as well as Ukrainian breeding activity focus on imported genetic resources can significantly reduce the domestic gene pool, leave an industry without resources for further improvement and without valuable animal population adapted to local conditions. We believe that state run public authorities must pay special attention to the development of a set of measures to support enterprises that are engaged in intensive work on improving genetic resources and the breeding industry base development. In particular, they are to provide full financing of specialized research institutions, breeding and genetic centers.

Aim of the article

A comprehensive analysis of Ukrainian breeding enterprises and reproducers development makes it possible to distinguish two periods in the development of the economic players operation during 2001-2014: the period of intensive development (2001-2007) and the crisis period (2008 – present). Thus, 39.8% increase in the number of breeding plants and 64.5% in the number of breeding reproducers was observed in the first period. A slight increase in the number of pigs in all categories should be noted during the period of intensive development along with increased funding for scientific research in the field of pig breeding.

As for the second stage, 42 breeding plants and 248 reproducers were discontinued during this period. One of the reasons for this situation was the reduction in livestock breeding funding. In fact, during 2012-2013, the level of financing covered only two-thirds of the need. In particular, in 2014, no funding was provided for the budget programs "Breeding in livestock and poultry farming in agricultural enterprises" (CPEC-2801190) and "Breeding in livestock and poultry farming in research and development farms" (CPEC-6591080).

Obviously, a rapid decrease in the number of breeding reproducers causes a decrease in pigs number. The number decreased by almost 82 thousand animals during 2001-2014.

However, despite the decrease in the number of breeding plants, the number of farm animals increased during this period by almost 90 thousand animals. This situation can be explained by the fact that the status of breeding plant was given to separate legal entities of vertically integrated structures which specialize in pig products production, processing and marketing.

It is obvious that ensuring the intensive development of pig breeding on the basis of breeding youngsters number increase and its productivity growth is possible due to the organization of an efficient reproduction system of the herd. That is why the study of the pig stock turnover in breeding farms depending on sex is an important direction of the pedigree base development.

The quality of genetic material is one of the factors providing the competitiveness of the pedigree pig breeding industry. According to some scholars, the decline of domestic pig breeding was caused by low quality of the products [6]. However, according to the data of the Ministry of Agrarian Policy and Food of Ukraine, the share of the main boars of "elite-record" and "elite" exceeds 90%, the sows number exceeds 85%.

Thus, a multidirectional change was found in the stock of main hogs and sows of the "elite-record" and "elite" classes during 2001-2014. It should be noted that in 2014 the hogs stock decreased by 59% along with 53.5% increase in sows. A qualitative change can be considered a positive moment - an increase in the share of the main herd of the "elite-record" and "elite" class hog stock structure at 5.56 pp, and in the sows - by 13.56 pp

Consequently, the presence of a negative tendency to reduce the pedigree stock will result in the problems in ensuring a balanced development of the pig products market. Domestic pig production is distinguished with shortage of breeding resources and specialized breeds of meat and bacon productivity, and the problem of domestic genetic resources quality remains unresolved. We have found out that most pig breeders are oriented towards using their own genetic resources to improve their quality. Thus, during 2001-2014, the breeding farms reduced significantly the amount of boars purchased - by 6.4 times, the gilts - by 4 times and sperm production by more than 10 times (Table 1).

The situation is obviously conditioned by difficulties in the in pig breeders economic activities financing as well as their low efficiency indicators, in particular the genetic material quality. Indeed, positive trends in the industry can provide an increase in agricultural producers demand for pedigree products. However, according to the Ministry of Agrarian Policy and Food of Ukraine, breeding farms have significantly reduced the volume of pedigree products sales.

Table 1. Dynamics of boars, gilts and genetic resources purchased by Ukrainian breeding farms

Year	Boars		Gilts		Pedigree (genetic) resources purchases	
	animals	% to 2001	animals	% to 2001	sperm doses	% to 2001
2001	8741	100,00	23072	100,00	1215	100,00
2002	7156	81,87	21284	92,25	1299	106,91
2003	5343	61,13	15452	66,97	1052	86,58
2004	5792	66,26	17644	76,47	1220	100,41
2005	6453	73,82	20223	87,65	1950	160,49
2006	6931	79,29	24156	104,70	1693	139,34
2007	4642	53,11	20210	87,60	1250	102,88
2008	5168	59,12	18737	81,21	1237	101,81

2009	4118	47,11	16881	73,17	950	78,19
2010	3139	35,91	15043	65,20	669	55,06
2011	3040	34,78	11760	50,97	902	74,24
2012	2398	27,43	9337	40,47	452	37,20
2013	1810	20,71	6247	27,08	269	22,14
2014	1365	15,62	5769	25,00	170	13,99

Source: developed and calculated according to the data of the Ministry of Agrarian Policy and Food of Ukraine

The data of Table 1 testify that during 2001-2014, breeding farms reduced the boars livestock sale amount by almost 5 times, sows – by 4 times, and domestic reproducers - reduced the amount, respectively, by 5 and 4.2 times. This tendency can be explained by both limitied financial resources of independent agricultural enterprises and the legislative barriers for selling breeding animals to private farms.

Meanwhile, economic changes in the country resulted in the breakdown of most production and technological chains. Also, the breeding stock of the best foreign breeding companies began to outperform significantly the domestic breeds due to inadequate acquisition of the domestic commodity enterprises with cross-bred young animals and lack of significant selection achievements in domestic pig breeding within the last 2 decades. Most large-scale farms of the corporate sector of the agrarian economy are known to be oriented towards the purchase of pedigree pigs of foreign selection for 100% compensation for the purchase of animals for breeding farms and 50% compensation for non-breeding ones, which stimulated genetic resources import.

It should be noted that the largest volumes of breeding pigs arrivals to farm enterprises of the corporate sector from abroad was observed during 2006-2008 and in 2012 when the state program for the farm animals selection support ran.

The largest suppliers of live pigs to Ukraine in 2014 were Germany (71% in the overall structure), Denmark (8.2%) and France (8.2%). The largest share ranks Large White breed - 48%, Landrace - 19, Yorkshire - 10, Large White of import selection - 15, Duroc – 6; other breeds account for 2%. Consequently, in the pig products market, there is a steady tendency to exclude a number of domestic breeds with their subsequent substitution by imported genetic resources.

Currently, there is a large number of world-known genetic companies on the domestic market, however, it is rather difficult to determine the amount of the breeding stock imported to Ukraine as the remount young animals are often imported under the guise of feeder pigs to reduce the cost of all the related procedures [7]. This precludes an objective assessment of the real situation regarding Ukrainian pig breeders dependence on foreign genetic resources import.

Hermitage Genetics (63.6%) and Breeders of Denmark (23.9%) occupy the largest share in the pure-breeding youngsters supply chain in 2014. At the same time, the volumes of pure-breeding stock are considerably inferior to the supply of hybrids. Also, the acquisition of the progenitor livestock allows to receive the remount material with appropriate qualitative figures, on condition of proper compliance with the requirements for the proper organization of the genetic process of the herd on their own.

Research results

It has been found out that currently the domestic producers of pig products do not use the breeding products of the world leader in pig breeding, i.e. the United States of America, though Asian countries, in which the development of pig breeding is growing rapidly, import actively pedigree young animals from this country. One of the obstacles to importing genetic resources from the US is the discrepancy between veterinary certificates of the countries.

To solve this situation, some genetic companies, which have repeatedly faced the problems related to the transportation of genetic material across the border and the imperfection of Ukrainian legislation, start to open their own representative offices on the territory of Ukraine. Thus, the world-

renowned Dutch genetic company Nurog BV, a member of the Hendrix Genetics group, established its representative office - Servolyuks-Genetik Ltd. (engaged in growing and selling Landrace and Big White maternal pure-bred remount pigs) - in the Orativsky district of Vinnytsia region at the beginning of 2010 [8]. PIC (Pig Improvement Company), the world leader in pig genetics improvement, plans to work up the Ukrainian market according to this approach.

The low efficiency of pig production in commodity farms is partly caused by poor quality of the breeding resources and the violation of integration ties between breeding farms and agricultural enterprises. Thus, the reproductive qualities of sows, including remount ones, for all breeds used in the farms were as follows: litter number - 12.0 animals, number of piglets in 30 days - 10.9 animals, the litter weight in 30 days - 87.6 kg, the weight of a 30 days old pig - 8.0 kg, that is, they correspond to the level of the elite class and the first class. In breeding plants and breed reproducers reproductive capacity of sows in all breeds was as follows: litter number - 12.1 and 11.8 animals, number of piglets in 30 days - 10.8 and 10.0 g., the litter weight in 30 days - 89.0 and 85.6 kg, the weight of a 30 days old pig - 8.2 and 7.8 kg, respectively [9].

The scientists research results prove that according to reproductive qualities the main domestic "maternal" breed of pigs - Large White – is inferior to the best world breeds. Consequently, taking into account the indicators of pig breeding efficiency in Ukraine, we can conclude that the genetic capabilities of domestic and imported genetic resources are not fully realized due to the imperfect organization of technological processes, especially the shortcomings in labor organization, inappropriate use of methods of cross-breeding and hybridization, insufficient and unbalanced nutrition, poor material, technical and production facilities [10].

According to the results of our research, we have systematized the factors of the crisis situation in the development of pig breeding, namely: low demand for breeding production in the agricultural producers; pig production and production means price disparity, feed, medicine and other products and services; violation of integration ties in the breeding products production and sale; reducing the level of state support for the development of scientific and technological progress of the industry; deterioration of the system of organizational and economic conditions in agricultural enterprises, etc.

We believe that one of the factors supporting the revival of pig breeding in Ukraine should be the effective economic regulation of the product market. However, the measures of state support to the agricultural sector and economic regulation levers are often controversial and not concerted with the real practice. The limitations of the state budget resulted in a dramatic reduction in centralized investments that were not timely transferred, which, in turn, affected the accumulation of public debt and devalued these payments. Meanwhile, the inaccessibility of loan funds and the decline in the profitability of pig enterprises have deprived them of the opportunity to upgrade their technological equipment, to complete construction of the facilities started as well as to carry out reconstruction and technical re-equipment.

It has been established that state support for leasing is important for livestock breeding development. Due to the complication of the financial situation of rural commodity producers, a new form of assistance to breeding farms in the implementation of breeding products for lease has been introduced since 1995, and agricultural enterprises-buyers have the opportunity to buy in installments and thus support the genetic potential and productivity of pig herds.

The processes of buying and selling pedigree animals got more active with allocating the lease fund money for breeding animals purchase. According to the State Statistics Service of Ukraine, the share of the pedigree animals purchase at the expense of the lease fund exceeds 10%. The practice of lease means use for the acquisition of breeding animals shows the low efficiency of the loans repayment mechanism. It is the loans repayment that needs to be amended under the current procedure in terms of increasing the duration of lease use and reducing the size of the down payment, as well as reducing the number of intermediaries in the lease system, which can have a positive effect in the agroindustrial chain. At the same time, the funds of the lease fund must be distributed among those who are ready to bear responsibility for their property, which will contribute to loans return through lease (Fig. 2).

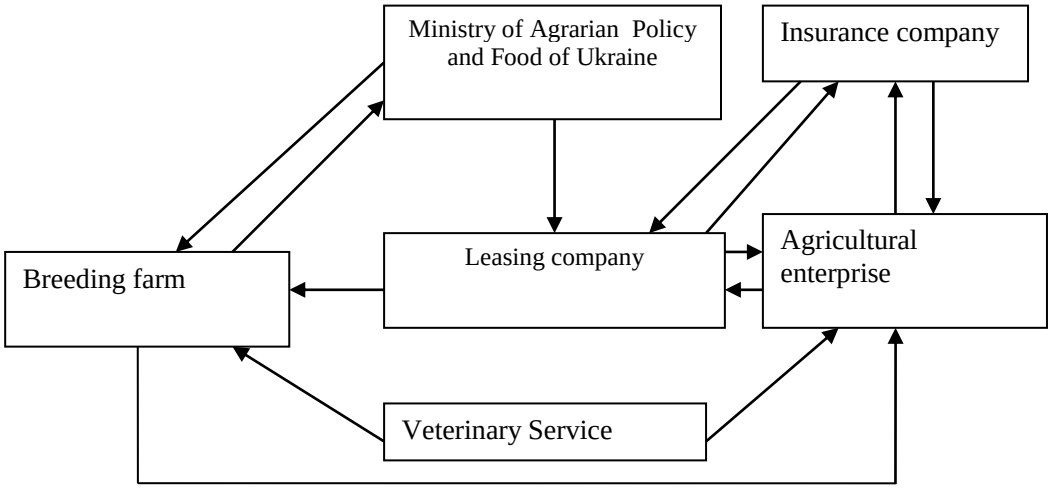

Fig. 2. Suggested scheme of breeding pigs lease
Source: developed by the authors

Lease operations accord with the current legislation, in particular, the Law of Ukraine "On Leasing", which specifies that farm animals are the objects of lease relations. We believe that the legal regulation requires clarification of the subjects of leasing relations in breeding stock purchase, namely the involvement of the following participants: agricultural enterprises registered as subjects of the breeding which have the certificate; a leasing company - financial intermediary; Ministry of Agrarian Policy and Food of Ukraine - an authority that controls the compliance of the status of a breeding plant or a reproducer and a financial manager of budget funds that must compensate the cost of purchased pigs due to a certain financial transaction in the amount of up to 2,400 UAH / animal; insurance company - a business entity that takes, for the relevant fee, the risks during the transport of pigs from the breeding farm to the agricultural enterprise-pig breeder and during their farming until the end of the lease agreement; veterinary service - a body that controls the conditions for pigs farming in a breeding farm, in an agricultural enterprise and during transportation; an agricultural enterprise - lessee.

Having summarized the results of the conducted research on pig breeding development, we systematized the economic and organizational tools and measures, which can provide its intensive development.

We believe that the system of taxation for pig breeding companies needs to be modernized, especially as regards the application of a single tax to group 4 of tax payers and the gradual introduction of the sales profit tax, which will enable the purchase of modern technologies for the agrarian sector, and, which is the most important, to ensure the competitiveness of pig products on the domestic and foreign markets.

Thus, pig breeding revival requires improvement of the regulatory and legal framework, as well as the distribution of functions (between the state and producers). Highly productive animals provide extra profits, therefore, agricultural producers interested in pedigree pig breeding should be concerned with it. However, in a real-world conditions, they are suspended from such work, due to their "legislative elimination" (Fig. 3).

Thus, the current legislation does not mention a private sector (personal peasant farms) among the subjects of livestock breeding while in Europe, they came to the conclusion that involvement of the state in breeding work slows down the process of introducing breeding innovations, and therefore, these issues are the prerogative of commodity producers and profile associations. The state is to perform only two functions, namely legislative initiative and control, namely to train veterinary, technology maintenance, feeding and breeding specialists. All these tasks should be discussed extensively with all the specialists of the Association member companies.

Special attention in breeding work, at the present stage of development of domestic pig breeding, should be paid to the commodity enterprises planned supply with remount cross-bred young

animals with high productive and adaptive qualities. Thus, the establishment of breeding and genetic centers in pig breeding is the most important condition for the implementation of hybridization and breeding programs for pigs on a three-level scheme [11].

According to the above-mentioned algorithm for the establishment of a pig breeding system at Level 1, pure breeding of specialized lines of meat breeds based on Large White, Yorkshire, Landrace, Durok, Pietrene, etc. should be carried out. It is obvious that 3-4 breeding herds with 4-5% of breeding stock as a part of the breeding system must be in the upper part of the breeding pyramid. The remount youngsters faming should be carried out on **elevers** with the yield assessment conducted using population genetics methods.

Level 2 is the maternal lines reproduction and obtaining several lines of cross-bred youngsters for the purpose of assembling commodity herds, which should make 12-11% of the breeding stock that are part of the breeding system.

Level 3 - the production of a three- and four-line hybrid livestock.

Selection Genetic Centers (SGCs) are to become the basis of the organizational structure of pig breeding in Ukraine. The breeding work of the SGC should be aimed primarily at the selection and improvement of the pedigree stock of pig maternal and paternal specialized combined lines by the method of closed linear pure-bred selection and obtaining cross-bred youngsters. It is necessary to ensure uninterrupted reproduction of breeding and cross-bred youngsters for breeding and commodity enterprises located in the zone of regional and interregional pig breeding system. Moreover, the obligatory conditions for breeding and selection genetic centers functioning are as follows: availability of at least three specialized maternal and paternal lines consolidated on reproductive, fattening, meat quality and appearance features, in breeding and selection genetic centers; the number of livestock must ensure its own reproduction in each herd to support breeding lines in a number of generations; remount youngsters assessment by their own productivity; automated zootechnical records with a data bank for breeding herds.

Conclusions

Forage base is an important element in the development of pig breeding as it can not only ensure quality feeds for pig stock but to reduce significantly the products cost. To solve this problem it is necessary to provide measures on forages protein and energy content increase, to increase the production volumes of forages with protein-vitamin and functional additives, to increase the production of extruded, dry forages, fodder soy concentrate for starter fodder, comprehensive improvement of liquid feed preparation directly on pig farms, etc.

Priority directions of scientific support for the development of breeding and breeding work should be: provision of feed in full to the needs; conducting purposeful veterinary and protective activities, in particular, development of requirements for biosafety and creation of an all-Ukrainian identification system, which will enable to control the safety of pig breeding; development and improvement of technology of breeding, industrial and small-scale raising and fattening of animals; expansion of the pedigree base of pigs by creating new farms of meat production direction; improvement of pig breeds by using the best world genetic resources, optimizing the composition of the rock based on the best domestic and foreign breeds; provision of organization of young pigs testing of by their yield performance; creation of new diets and feeding technologies. We believe that the functioning of the regional and the creation of an interregional system of pig breeding in the medium dated prospect based on the organization and operation of new types of enterprises - breeding and genetic centers - will enable the creation of a domestic competitive breeding base and the production of highly productive hybrid fattening youngsters.

REFERENCES

1. Lymar V. How not to lose breeding stock / V. Lymar // Agrar. week. Ukraine (newsp.). - 2013. - No. 29-30. - P. 26-27.

2. Mykytiuk D. What does intensive pig production depend on? / D. Mykytyuk, I. Kolesnik, M. Geymor // Proposal. - 2010. - No. 12. - P. 127.
3. The history of pig breeding and its present / V.M. Voloshchuk, A.A. Getia, V.G. Tsybenko, N.D. Holub // Effective animal husbandry. - 2013. - No. 7. - P. 18-22.
4. Rybalko V. Breeding pigs / V. Rybalko // Agrobusiness today. - 2010. - No. 19/20. - P. 34-35.
5. Smirenko I.V. Pig farming as a successful business / I.V. Smirenko, G. Onishchenko // Pig Production in Ukraine. - 2012. - No. 9. - P. 9.
6. Petrenko V. Import versus domestic again / V. Petrenko // Farm enterprise - 2010. - No. 20. - P. 20.
7. The Government Courier visited a Servolux-Genetic Ltd. [Electronical resource]. - Available at: http://www.servolux.com.ua/content/uryadoviy-kurier-pobuvav-v-gostyah-u-tov-servolyuks-genetik
8. Voitenko S. Genetic potential is high. And performance? / S. Voitenko // Livestock of Ukraine. - 2010. - No. 4. - P. 2-3.
9. Lisny V. Species of the perspective gene pool / V. Lisny, O. Pohvalenko // Agrar. week. Ukraine (newsp.). - 2011. - No. 19. - P. 14.
10. Ibattuulin M.I. Organizational and economic principles of the implementation of pig production by individual peasant farms / M.I. Ibattuulin // Bullet. Sumy National agrarian uni. Series "Economics and Management". - 2015. - V. 12 (66). - P. 72-76.
11. Gadyssov M.G. On cattle markets as an instrument of livestock market circulation / M.G.Gadusov // Economy structuring issues. - 2012. - No. 2. - P. 35-40.

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THE INFLUENCE OF DRYING CONDITIONS ON THE EFFECTIVE MOISTURE DIFFUSIVITY AND ENERGY OF ACTIVATION DURING THE HOT AIR DRYING OF RED BEETROOT

CECLU LILIANA,
Associate professor, PhD in Technical Sciences,
Cahul State University "Bogdan Petriceicu Hasdeu"
E-mail: ceclu.liliana@gmail.com

Abstract. *The main goals of the present work are the influence of drying characteristics on red beetroot, effective moisture diffusivity determination and the activation energy. The drying characteristics of red beetroot were investigated theoretically and experimentally by convection drying at different air temperatures, ranging 50 – 80ºC and relative humidity 30,6 – 53,8%. Red beetroot samples were dried from moisture content of 88,84±0,35% until 9.88±0.5%. The results have shown that, increasing the drying air temperature causes shorter drying times from 450 min to 240 min. Moisture transfer from red beetroot samples was described by applying the Fick's diffusion model. The effective diffusivity coefficient of moisture transfer varied from 1,471x10^{-8} to ,.8145 x10^{-8} m^2/s in first stage and 6,0094 x10^{-8} to 1,19x10^{-7}m^2/s in second stage of drying process, over the temperature range analised. The temperature dependence of the diffusivity coefficients was described by Arrhenius type relationship and was found to be 22,33 kJ/mol in first stage and 19,85kJ/mol in second stage of drying process.*

The research aimed to establish the kinetics of the drying process of red beetroot, in order to investigate the optimal drying parameters for this vegetable.

Keywords: *red beetroot, convection, drying kinetics, moisture content.*
UDC: 338.45

1. Introduction

The fruits and the vegetables are the fundamental items of a balanced diet. This group of products is considered as the main source of bioactive compounds and minerals, carbohydrates such as simple sugars (glucose, fructose, sucrose), polysaccharides, cellulose (such as hemicellulose), gums and pectic substances, in varying proportions, fibers, micro and macronutrients, but also a high water content, up to 94%.

Due to the seasonal character of food products it requires their preservation. Drying is intended to preservation of food products, which can be used as a primary operation or a intermediate storage process.

Dried fruits are one of the healthiest alternatives to refined sugar and great way to satisfy the sweet appetite. Chips from dried fruits and vegetables can be a quick and tasty snack during a busy day. However, dried fruits should be eaten in moderation because of high sugar content and high intake of kilocalories.

Dried fruits and vegetables besides being consumed as raw products, represents a feedstock for a wide range of food products, medicines and pharmaceuticals.

Drying represents one of the most used methods for preserving food [1]. This process is based on the biological principle of xeroanabiosis, which is characterized by partial removal of humidity from the product, or to a level that results in disruption, reduction or cessation of the microorganisms' vital functions. Low moisture content at which the bacteria grow is between 25-30%, while for yeasts is 10-15% [2].

The using of drying as a preservation method offers the possibility of obtaining a wide range of new products while extending their shelf life. Dried food products have the advantage that occupies a low volume and weight compared to the raw materials. This aspect has a direct impact significantly reducing the storage and transportation of dry products [3].

Drying is one of the most complex processes in food industry and one of the most commonly subjects studied in food engineering field. Optimizing this process can reduce production costs and improve product quality [4].

Beetroot (*Beta vulgaris*) is rich in valuable, active compounds such as carotenoids, glycine betaine, saponins, betacyanines, folates, betanin, polyphenols and flavonoids [5, 6]. However, fresh beetroots are exposed to spoilage due to the high moisture content. One of the preservation methods which is ensuring the microbial safety of biological products is drying. Dried beetroot can be consumed directly in the form of chips as a substitute of traditional snacks, that are rich in trans fatty acids, or after easy preparation as a component of instant food.

Convective drying in hot air is still the most popular method applied to reduce the moisture content of fruits and vegetables. The main objective in drying food products is the removal of water content up to a certain level, at which microbial spoilage and deterioration chemical reactions are greatly minimized [7]. Other important objectives of food dehydration are weight and volume reduction, intended to decrease transportation and storage costs.

This study has the aim to establish the kinetics of the drying process of red beetroot, in order to investigate the optimal drying parameters for this vegetable.

Abbreviations:
MR, moisture ratio, dimensionless;
DR, drying rate, (g water/g dry matter)/min;
M, moisture content, g water/g dry matter;
M_0, initial moisture content, g water/g dry matter;
M_e, equilibrium moisture content, g water/g dry matter;
RH, relative humidity, %; t, drying time, min.

2. The degree of investigation of the problem currently, and purpose of research

Drying is a commonly used technique for improving the product stability of biotherapeutics or nutraceuticals properties of foods. Most plant products contain high water content (typically ≥80%, w/w). Removal of water through drying provides numerous benefits, including ease of handling and storage, reduction in transportation costs, and improved stability [8].

Drying process involves the application of heat to remove moisture and some means of carrying-off water vapor after its separation from the tissue plant products. Therefore, the drying process is a complex unit operation that is carried out with simultaneous heat and mass transfer with the energy supply.

Although all drying techniques share a common objective, conceptually they are different and require modification/adaptation based on the properties of the compound. Control of process parameters of drying is essential to both the quality of the product and the economics of the process. Chemical reaction kinetics, microbial activity and physical structure in foods all depend on moisture content, or the corresponding water activity. Hence, is most immportant to predict the variation moisture content in food, during processing.

The choice of drying method depends on several factors including the physical properties of the product, application of the product, type of energy source available, container closure system, and scalability of the equipment. Drying process may be performed by convection (direct dryers), by conduction (contact or indirect dryers), radiation or volumetrically by placing the wet material in a microwave or radio frequency electromagnetic field. In addition, forced air or vacuum may be applied to enhance the rate of dehydration. Over 85 percent of industrial dryers are of the convective type with hot air or direct combustion gases as the drying medium. Over 99 percent of the applications involve removal of water. All modes except the dielectric (microwave and radio frequency) supply heat at the boundaries of the drying object so that the heat diffuses into the solid primarily by conduction. The liquid must travel to the boundary of the material before it is transported away by the carrier gas (or by application of vacuum for non-convective dryers) [9].

Several models are found in the literature, representing mass and energy transfer which take place during food drying. Usually, approximate solutions are obtained with these models by fixing geometric characteristics (slab, sphere or cylinder) and considering constant transport properties.

Currently most of the dried fruits and vegetables are produced by the technique of convective drying, which is the simplest and most economical among the various methods. Air is generally used as the drying medium because it is plentiful, convenient, and overheating of food can be controlled.

3. Methods and materials applied

3.1. Raw material

Red beetroot *(Beta vulgaris L. var. Cylindra)* was purchased from a local market.The initial water content of the fresh material varied between 0,84-0,85 kg/kg. The red beetroots were washed, peeled and cut into parallelepipedic slices 20 mm in length, 20 mm in width, and 5 mm in thickness.

3.2. Drying process

The drying studies were conducted in the laboratory of unit operations at the Food Science and Engineering Faculty of Galati. The beetroot drying process was performed in a convection dryer at 50, 60, 70 and 80°C temperature and 30.6 – 53.8% RH values. All drying experiments were triplicated, and average values regarded.

4. Results obtained and discussions

The drying curves of red beet obtained from experiments, $M=f(t)$, where M is the moisture content of red beets in dry basis and t is the elapsed drying time in min, were converted into dimensionless moisture content MR (moisture ratio) using the following equation (1):

$$MR = \frac{M_t - M_e}{M_0 - M_e} \qquad (1)$$

where M_0 is the initial moisture content (g water/g dry matter), M_t is the moisture content at any time (g water/g dry matter) and M_e is the equilibrium moisture content (g water/g dry matter). The value of M_e was determined as the moisture content at the end of drying when the samples stopped to lose weight [10].

Moisture ratio (MR) represents the amount of moisture remaining in the red beetroot samples reported to the initial moisture content.

The effect of drying temperature on the moisture ratio is shown in Picture1. The curves reveal that the decrease of moisture content with time is in a non-linear fashion, indicating that the moisture movement is controlled by diffusion and that diffusion is dependent on the moisture content of the samples.

From graph shown in Picture 1, can be observed the influence of temperature during drying on the moisture content of red beetroot samples. Increasing the drying temperature reduces the drying time. The time needed to reach equilibrium moisture content decreased with increase in temperature.

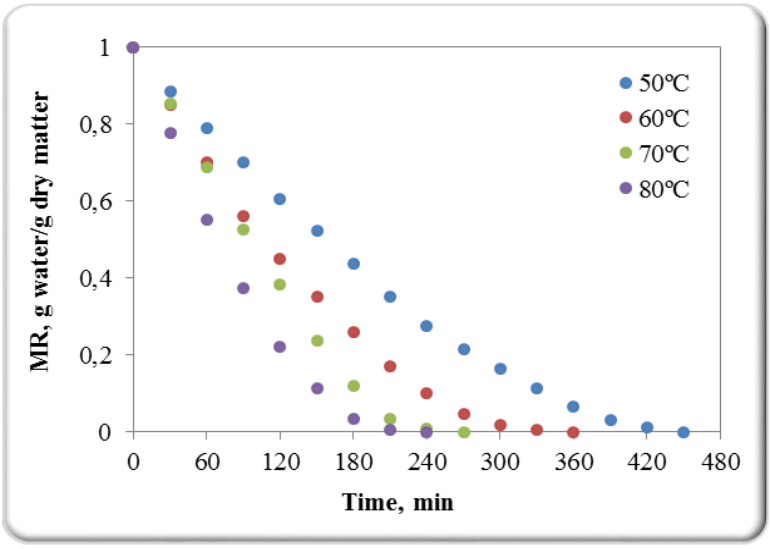
It is obvious from Pictures 1 and 2 that increasing the drying temperature caused an important increase in the drying rate, thus the drying time is decreased.

Drying rate were calculated as quantity of moisture removed per unit drying time per unit dry solids.

The drying rate (DR) of red beetroot samples can be determined using the following equation (2):

$$DR = \frac{M_{t+dt} - M_t}{dt} \qquad (2)$$

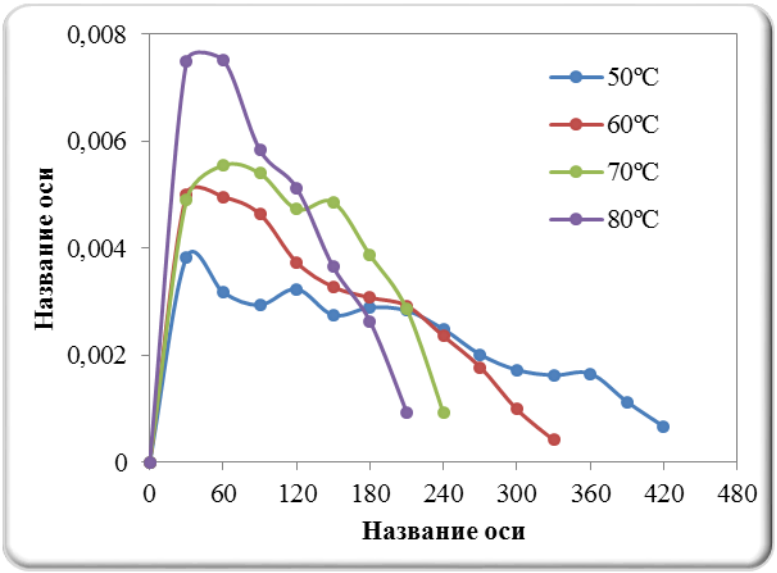
where M_{t+dt} is moisture content at time $t + dt$ (g water/g dry mater), t is the time (min) [10].



Picture 1. Effect of drying air temperature and drying time on the moisture ratio of red beetroot samples.

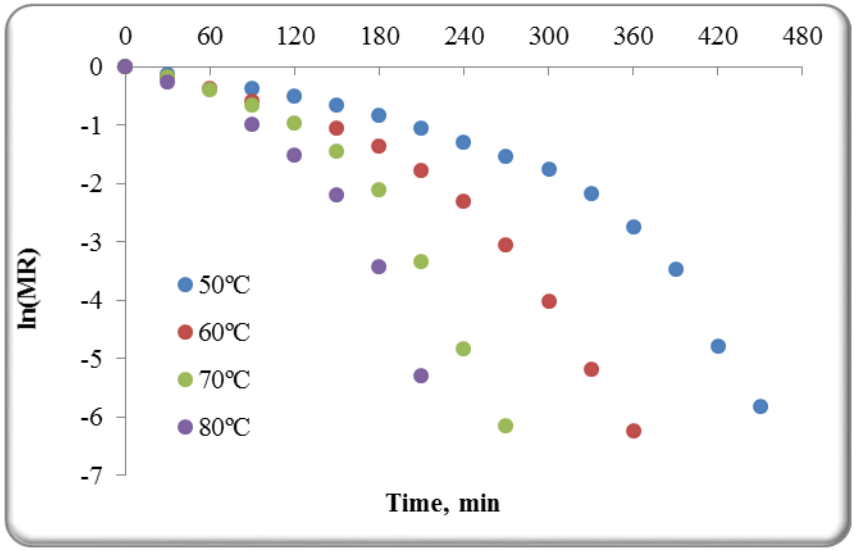
In Picture 2 is shown drying rate curves of red beetroot samples. It can be observed that the drying rate intensify with increasing temperature and decreases with increase in drying time of irrespective of drying temeperature.

Theoretical studies of drying indicate that the drying process can be divided into a constant drying rate period and one or two falling drying rate periods. This constant drying rate period is missing from most products with capillary-porous structure such as fruits and vegetables.



Picture 2. Drying rate of red beetroot samples changes with drying time.

In the case of red beet samples, the constant drying rate is too short (insignificant) or missing totally. This stage being followed by a falling drying rate period. As the samples dries, water becomes less available on the surface and diffuses from the centre. A moisture gradient between the centre and the surface is installed and drying rate will progressively fall until equilibrium with the drying air is reached. During this period the mechanism of internal moisture flow dominates the rate of drying.



Picture 3. Logarithmic drying curves at various temperatures for red beetroot samples.

The effective moisture diffusivity is an important transport property in modeling of food drying process, being a function of temperature and material moisture content.

In drying process, liquid diffusion is generally accepted to be the main mechanism during the transport of moisture to the surface in order to be evaporated. This important phenomenon was described analytically by Fick in 1855 [11].

When liquid diffusion controls the internal movement of moisture and it occurs only in one dimension Fick's equation can be written as

$$\frac{\partial C}{\partial t} = -D_{eff}\frac{\partial^2 C}{\partial x^2} \qquad (3)$$

where

C is the concntration of the diffusing substance (g/m^3) at distance *x* (m) along the diffusion path, and

D_{eff} is the diffusion coefficient (m^2/s).

Crank using Fick's second law proposed Eq. (4) for the effective moisture diffusivity for an infinite slab [12].

$$\frac{M-M_e}{M_0-M_e} = \frac{8}{\pi^2}\sum_{n=0}^{\infty}\frac{1}{(2n+1)^2}exp\left(\frac{(2n+1)^2\pi^2 D_{eff}t}{L^2}\right) \qquad (4)$$

where

D_{eff} is the effective diffusivity (m^2/s),

and

L is the thickness of samples (m), n is a positive integer.

For longer drying periods is necessary to make some simplifying assumptions. It is assumed that moisture transfer is unidirectional, the initial moisture is uniformly distributed and the diffusion coefficient of moisture is constant and negligible shrinkage

$$MR = \frac{M-M_e}{M_0-M_e} = \frac{8}{\pi^2}\exp\left(-\pi^2 D_{eff}\frac{t}{L^2}\right) \qquad (5)$$

The diffusion coefficients are typically determined by plotting experimental drying data in terms of ln(MR) versus drying time (t), [13].according to Eq. (6):

$$slope \quad k = \frac{\pi^2 D_u \tau}{L^2} \qquad (6)$$

The non-linear shape of drying curves (Picture 3.) indicates variable moisture diffusivity. Each curve consist of two falling rate periods (linear shape) for drying.

The linear regression analysis was employed to calculate the diffusion coefficients from the slopes of the straight lines. The diffusion coefficients were calculated for the first falling rate at each temperature. The diffusion coefficients for second falling rate periods were calculated without shrinkage for each temperature.

In Table 1 are shown the diffusion coefficients for each temperature in both falling rate periods, and regression coefficient

Table 1. Effective moisture diffusivity and correlation coefficient at different temperatures for first and second falling rate periods

t (°C)	R^2	D_{eff1} x10^{-8} (m^2/s)	R^2	D_{eff2} x10^{-8} (m^2/s)
50	0,9771	1,4706	0,9891	6,0094
60	0,9834	2,0792	0,9841	7,7336
70	0,9849	2,3835	0,9849	10,2692
80	0,9934	2,8145	0,9867	11,9935

It can be seen that the values of D_{eff1} and D_{eff2} increased greatly with increasing temperature. Drying at 80°C gave the highest D_{eff} values in both stages.

The dependence of the diffusivity coefficient on temperature is often given by an Arrhenius type equation [14]

$$D_{eff} = D_0 exp\left(-\frac{E_a}{RT}\right) \qquad (7)$$

where

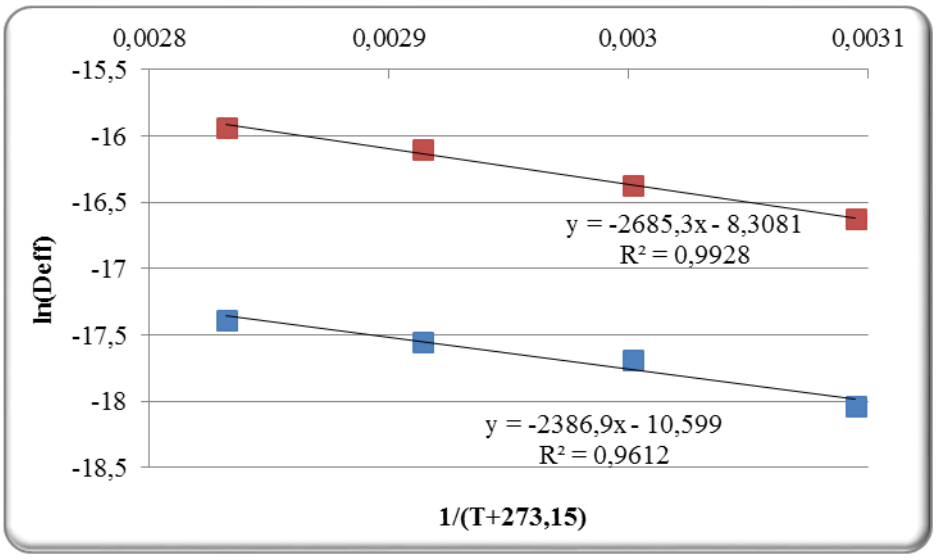
E_a is the activation energy of the moisture diffusion in kJ/mol;

D_0 is the pre-exponential factor of Arrhenius equation m^2/s; D_{eff} is the moisture diffusivity m^2/s;

R represents the universal gas constant kJ/mol·K

and

T_a is the absolute drying air temperature in K.



Picture 4. The relationship between ln(D_{eff}) and 1/(T+273,15)

The activation energy can be determined from the slope of the Arrhenius plot, $\ln(D_{eff})$ versus $1/T_a$. [15]

The activation energy calculated from the slope of the straight line in Picture 4. It was found to be 22,33 kJ/mol in first stage and 19,85 kJ/mol in second stage. The activation energy for water diffusion in first stage is higher than activation energy in second stage.

5. Conclusions

Drying behavior of red beetroot slices was investigated in a hot air dryer at 50, 60, 70 and 80˚C. The obtained results showed that total time of drying was reduced substantially with the hot air temperature increasing from 450 min at 50˚C to 240 min at 80˚C. The highest effective diffusion was found to be from 6,0094 $x10^{-8}$ up to 1,19$x10^{-7}m^2/s$ in second stage. The lowest effective diffusion was from 1,471$x10^{-8}$ to 2,8145 $x10^{-8}$ m^2/s in first stage of drying process. The temperature dependence of the diffusivity coefficients was described by Arrhenius type relationship and was found to be 22,33 kJ/mol in first stage and 19,85 kJ/mol in second stage. It can be seen that temperature significantly affected the drying process.

REFERENCES

1. MUJUMDAR, A.S., LAW, C.L. *Drying technology: Trends and applications in postharvest processing*. Food and Bioprocess Technology, 2010, 3: 843–852;
2. MUJUMDAR, A.S. *Drying: Principles and Practice*. International Workshop on Drying of Food and Biomaterials, 2011, Bangkok;
3. MAYOR, L., SERENO, A.M. *Modelling shrinkage during convective drying of food materials: a review*. Journal of Food Engineering, 2004, 61: 373–386;
4. MUJUMDAR, A.S. Handbook of Industrial Drying, Fourth Edition. CRC Press, 2014;
5. FIGIEL, A. *Drying kinetics and quality of beetroots dehydrated by combination of convective and vacuum-microwave methods*. Journal of Food Engineering, 2010, 98/4, 461-470;
6. KOWALSKI, S.J. & ŁECHTAŃSKA, J.M. *Drying of red beetroot after osmotic pretreatment: Kinetics and quality considerations.* Chemical and Process Engineering 2015, 36 (3), 345-354 DOI: 10.1515/cpe-2015-0024;
7. RAKCEJEVA, T., GALOBURDA, R., CUDE, L. & STRAUTNIECE, E. *Use of dried pumpkins in wheat bread production*, Procedia Food Science, 2011, 1 441 – 447;
8. WALTERS, R.H., BHATNAGAR, B., TCHESSALOV, S., IZUTSU, K.I., TSUMOTO, K., OHTAKE, S. *Next Generation Drying Technologies for Pharmaceutical Applications*. REVIEW. Journal of Pharmaceutical Sciences, 2014, Vol. 103, 2673–2695;
9. MUJUMDAR, A.S., DEVAHASTIN, S. *Fundamental principles of drying*. in *Industrial Transfer Processes. ME5202 /* Mujumdar, A.S. Department of Mechanical Engineering National University of Singapore, (2011/2012), Chapter one, pp. 2
10. ZAREIN, M., SAMADI, S.H., GHOBADIAN, B. *Investigation of microwave dryer effect on energy efficiency during drying of apple slices.* Journal of the Saudi Society of Agricultural Sciences (2015) 14, 41–47;
11. DARVISHI, H., ASL, A.R., ASGHARI, A., NAJAFI, G. AND GAZORI, H.A. *Mathematical Modeling, Moisture Diffusion, Energy consumption and Efficiency of Thin Layer Drying of Potato Slices*. Journal Food Process Technol, 2013, 4:3;
12. CRANK, J. (1975). *The Mathematics of Diffusion*. Second Edition, Clarendon Press, Oxford, UK;
13. MASKAN, M. *Drying, shrinkage and rehydration characteristics of kiwifruits during hot air and microwave drying*. Journal of Food Engineering, 2001, 48: 177-182;

14. GÖĞÜŞ, F., MASKAN, M. *Air drying characteristics of solid waste (pomace) of olive oil processing*. Journal of Food Engineering, 2006, 72: 378–382;
15. ARÉVALO-PINEDO, A., MURR, F.E.X. *Kinetics of vacuum drying of pumpkin (Cucurbita maxima): Modeling with shrinkage*. Journal of Food Engineering, 2006, 76: 562–567;

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STUDY OF STRUCTURE PARAMETERS AND OF ABSORBTION CAPACITY OF ACTIVATED CARBON OBTAINED FROM WOOD CHARCOAL

CIBOTARU SILVIA,
Scientific Researcher
Institute of Chemistry, Republic of Moldova
silvia.popovici@gmail.com

Abstract. *This paper presents the results of scientific research aimed at studying processes of obtaining activated carbon from wood charcoal. We presented methods for determining the structure parameters and specific surface of carbonic adsorbents. Scientific research results allow concluding that wood charcoal is a cheap and effective material for the synthesis of activated charcoal.*

Key words: *activated carbon, wood charcoal, physico-chemical activation, pore volume, specific surface area.*

UDC: 674.8(478)

Introduction

Active charcoal is a product that is increasingly sought after and increasingly used in the economy by various industries, and its special qualities, especially in the medical field, have definitively imposed it on the world market. Carbon adsorbents in this field are used as enterosorbents and hemosorbents for the detoxification of the human body. These opportunities for active coal characterize it as a product of prime importance in the economy.

The production of the wide assortment of activated carbon and the rapid development of activated carbon production is due to the numerous applications in the various branches of the economy, the considerable advantages it offers to the activated charcoal vis-à-vis other adsorbents as well as to the more frequent use in various technological processes. The volume of active coal production continues to increase, while improving its qualitative parameters [1, p.224].

The activated charcoal consists of a carbon framework with very fine channels and pores of varying depths and diameters. They exhibit the property of fixing and retaining on the surface the organic and inorganic substances with which they come into contact [2, p.216; 3, pp. 37-42].

Due to their physical and chemical properties, activated charcoal are specific and ideal sorbent materials, which solve many problems of chemical and biological purification of the human organism as well as of the environment. Active charcoal, being extremely porous materials, has a considerable internal surface. Due to the adsorption forces, in the porous structures of active coals (in the volume of micropores and mesopores) adsorption of different types of contaminants takes place [4, pp.425-435].

Activated charcoal can be obtained by three physico-chemical, chemical and mixed processes. The most commonly used is the physico-chemical activation process, which is based on the interaction of oxygen, carbon dioxide or water vapor with heavy hydrocarbons filling the pores of the activated carbonized material and/or amorphous carbon atoms in the charcoal skeleton. This process applies only when plant substances are already charred [5, pp 170-175]. As an example, wood charcoal, fruit kernels, nut shells, earth charcoals, synthetic organic polymers, etc., can be considered as a combination of amorphous coal and hydrocarbons. The activation process is carried out at temperatures of 800-1100^{o}C in special furnaces.

Various materials rich in carbon are used as a raw material for the production of activated carbon, e.g. wood, peat, and coal. In the production of active coals used for anti-gas masks and other specific uses, which must have increased mechanical strength and high volume of micro- and super-microporous material as raw material, coconut shell is used. It also mentions the use of metal carbides, carbon black, lignin, waste tires, waste from the production of polyvinyl chloride and other synthetic polymers [6, pp.803-804].

It has been established that with increasing the ratio of the number of H: C to O: C atoms, the activation process of the feedstock is facilitated. On the other hand, in the case of a fairly pronounced

ratio, it is necessary to remove a considerable part of the volatile substances from the raw material. For these purposes, the coaling process is used [7, 592 p.; 8, 264 p.].

Methods and materials

For the production of activated coal wood charcoal made in Straseni (M-S) and Calarasi (M-C) was used, intended for the preparation of meat and fish dishes. It is more widespread and accessible than other raw materials.

Structural parameters and adsorption capacity of activated carbon depends on many factors, among which the most important are: activity time, activation temperature, steam flow, quality and origin of charcoal [9, p.271].

It was established that with increasing ratio H:C and O:C, the raw material activation is enhanced. However, a significant ratio requires the elimination from the raw material of a large proportion of volatile substances. The charcoal burning procedure is used for such purposes [10, p.469-474].

The structure parameters and the geometric surface of the carbon adsorbents were determined from the adsorption-nitrogen desorption isotherms at 77°K [11]. Research has been done on the 1 MP Autosorb. The structure parameters and the active carbon adsorption capacity depend on several factors among which the most important are: time of activity, activation temperature, water vapor flow. An example of such adsorption-desorption isotherms is shown in Figure 1.

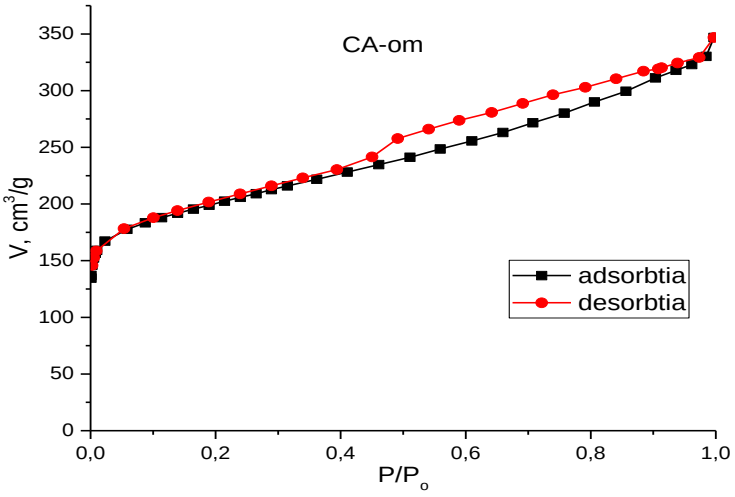

Figure 1. Adsorption and desorption isotherms of nitrogen (77K) on activated carbon of Straseni wood charcoal activated 60 min at 850 °C

The precise and objective determination of the maximum adsorption value (am) can be ensured by applying the Brunauer, Emmet, Teller (BET) adsorption isotherm [12, pp 1934-1936; 13, pp.165-190].

The geometric surface area of the active coals was calculated using the BET equation in its linear form:

$$\frac{P/P_s}{a(1-P/P_s)} = \frac{1}{a_m c} + \frac{c-1}{a_m c} \cdot P/P_s \quad (1)$$

where

a represents the adsorption at relative P/Ps pressure;

am - adsorption at P/Ps = 1 pressure;

C - the constant that depends on adsorption heat and adsorption condensation.

In fact, the following correlation is set:

$$\frac{P/P_s}{a(1-P/P_s)} \quad \text{from } P/P_s \tag{2}$$

As seen in Figure 2 it is a linear correlation.

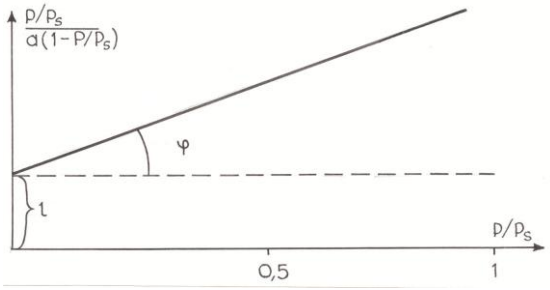

Figure 2. Adsorption isotherm in the coordinates of the linearized BET equation.

The values a_m and C from the presented equations are determined using this figure:

$$\operatorname{tg}\varphi = \frac{c-1}{a_m c} \tag{3}$$

$$l = \frac{1}{a_m c} \tag{4}$$

The geometric surface (S) of the activated carbons was calculated using the following correlation:

$$S = a_m \cdot \omega \cdot N \tag{5}$$

Where

ω is the area occupied by an adsorption molecule in the compact monomolecular adsorption layer;

N is the Avogadro number.

The volume of adsorbed and desorbed nitrogen is used in special programs to determine the adsorption capacity and active carbon structure parameters.

The sorption volume (V_s) of pores is calculated from the mathematical relation:

$$V_s = a_m \cdot V^* \tag{6}$$

where V * is the molar volume of the adsorbate.

In order to determine the quality of the activated carbon thus obtained, a number of determinations, including the iodine and methylene blue indices, were performed. As a result of the investigations, it was determined that the iodine value was 1015 mg I_2/g, whereas the adsorption capacity to methylene blue was 110 mg I_2/g. In this type of active coal predominate micro- and mesopores.

The dimensions of the activated carbon pores were determined from adsorption-desorption isotherms. An example of a pore distribution curve on their dimensions is shown in Figure 3.

Pore size distribution of the homogenised activated carbon sample obtained from Straseni wood charcoal activated 60 min at 850 °C.

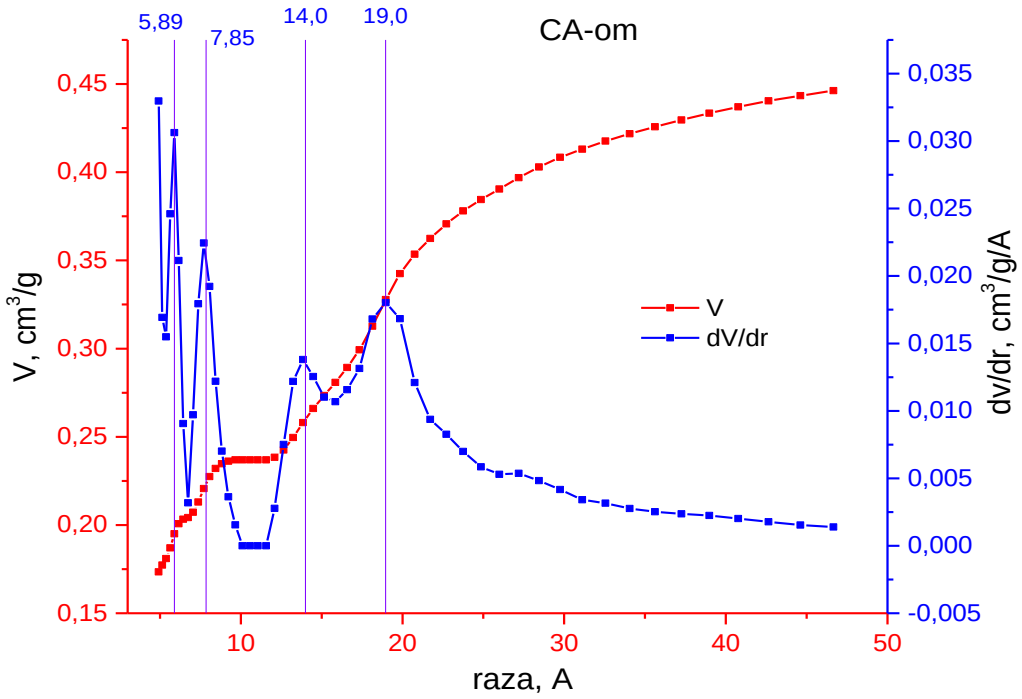

Figure 3. Pore size distribution of the homogenized activated carbon sample obtained from Straseni wood charcoal activated 60 min at 850°C

Results and discussions

The results obtained with respect to geometric surfaces, process yield, pore absorption volume according to activation temperature, water vapor flow, activation time and charcoal type are shown in Table 1.

Table 1: Quality indices of activated carbon charcoal obtained by physico-chemical activation

Type of CA	Temperature, °C	Time, min	Vapor flow, mL/min	Rate, %	Specific surface, m^2/g	Sorption volume, cm^3/g
S-1	850	30	6	78,1	625	0,402
S-2	**850**	**50**	**6**	**69,2**	**633**	**0,416**
S-3	850	70	6	43,4	833	0,574
S-4	850	90	6	21,3	947	0,631
S-5	850	120	6	-	-	-
C-1	850	30	6	70,6	580	0,332
C-2	**850**	**50**	**6**	**69,0**	**698**	**0,425**
C-3	850	70	6	54,4	807	0,612
C-4	850	90	6	44,4	794	0,592
C-5	850	120	6	30,3	649	0,624
T-1	950	30	6	20,0	1249	0,825
T-2	950	50	6	-	-	-
T-3	750	30	6	69,0	563	0,340
T-4	750	50	6	65,3	644	0,381
T-5	750	70	6	59,3	660	0,490

D-1	850	30	12	51,3	643	0,406
D-2	*850*	*50*	*12*	*44,4*	*892*	*0,683*
D-3	850	70	12	30	963	0,755
D-4	850	90	12	18,8	1216	0,837
D-5	850	120	12	6,0	1007	0,783

The analysis of the results presented in the above tables allows us to conclude that the geometric surface of the active coals depends on the activation time, the water vapor flow, the temperature of the chemical process. Thus, increasing the activation time at 850 ºC from 30 to 90 minutes leads to an increase of the geometric surface of the active coils from 625 to 947 m^2/g for a water flow rate of 6 mL/min. (Table 1).

The geometric surface area of carbon adsorbents increases under similar activation conditions from 643 to 1126 m^2/g increasing the water vapor flow from 6 mL/min to 12 mL/min.

This is explained by the fact that the increase in water flow leads to an increase in vapor mass that reacts more intensely with amorphous carbon, volatile substances in charcoal moving the chemical equilibrium of the reactions below to the right.

$$C(\text{carbon amorf}) + H_2O \xrightarrow{t^oC} CO + H_2 + \Delta H$$

$$C_x H_y O_z\,(\text{substanțe volatile}) + H_2O \xrightarrow{t^oC} XCO + YH_2 + \Delta H$$

The increase in the geometric surface of the active coals is synchronized with the increase in the sorbtive volume of the pores. Thus, the sorbent volume of the pores increases from 0.402 to 0.631 cm^3/g for water flow rate of 6 mL/min (tab.1) and from 0.406 to 0.783 cm^3/g for water flow rate of 12 mL/min. A special role in the process of producing activated carbon has its activation temperature.

Thus, the results presented in Table 1 show eloquently that increasing the activation temperature under the same conditions leads to an increase in the active carbon quality indices. Increasing the activation temperature from 750 °C to 950 °C results in an increase in the geometric surface of the active carbon from 563 to 1249 m^2/g for activation time 30 min and vapor flow rate 6 ml/min. Under the same conditions, the sorbent volume of carbonic adsorbents increases from 0.340 to 0.825 cm^3/g. This is explained by the fact that the increase of the activation temperature increases the water vapor diffusion coefficient in the porous structure of the charcoal, which interacts more intensely with the amorphous carbon atoms and with the volatile substances in the carbonized wood [14, pp.93-97].

The analysis of the results presented in the table shows that the increase in the geometric surface area and the volume of active carbon pores is proportional to the increase of the temperature and the activation time up to certain values after which these quality indices diminish. This is explained by the fact that under such conditions the carbon atoms are intensely oxidized in the graphite structure of the charcoal. Another quality index that influences the efficiency of carbon dioxide production is the yield of the process of producing activated carbon. This parameter decreases proportionally with increasing the time, activation temperature and water vapor flow. The efficiency of the activated carbon production process decreases as the surface area increases and the pore volume of the carbonate adsorbents increases.

Conclusions

- Quality of activated carbons, determined and presented in the current paper, shows that the charcoal obtained from Straseni wood and that obtained from Calarasi wood represents a good and cheap source of obtaining carbonic adsorbents.
- Quality indices of carbonic adsorbents can be programmed depending on the application, by varying the temperature and activation time and the flow of water vapor.

- The geometric surface and pore volume of activated carbons is proportional to the increase of temperature and activation time up to certain values and then these indices decrease.
- Activation time, temperature, vapor flow was established to produce activated carbon with high specific structure and surface parameters. Activated charcoal can be used in various environmental treatment processes.

REFERENCES

1. Lupaşcu T. Cărbuni activi din materii prime vegetale, Chişinău, ÎEP: Ştiinţa, 2004, 224 p.
2. Кинле Х., Бадер Э. Активные угли и их промышленное применение/ Пер. с нем. Л.: Химия, 1984, 216 с.
3. Lupascu, T.; Ciobanu, M.; Botan, V.; Gromovoy, T.; Cibotaru, S.; Petuhov, O.; Mitina T. Study of hydrogen sulfide removal from grundwater. Chemistry Journal of Moldova, 2013, 8(1), pp. 37-42.
4. Т. Лупашку, Р. Настас. Синтез, исследование пористой структуры, адсорбционных свойств и применение новых косточковых активных углей // В книге ,,Адсорбция адсорбенты и адсорбционные процессы в нанопористых материалах" , Москва 2011, с. 425-435.
5. Lupaşcu, T. Modern technologies for obtaining activated carbons and its use for the environment protection and human helth. / In Romanian. Buletinul ASM, Seria ŞBCA, 2004, nr 1, pp 170-175.
6. Noriyuki Y.; Motoi M. Carbonization of bamboo and consecutive low temperature air activation. Wood Sci Technol, 45, 2011, pp 803-804.
7. Кельцев Н.В. Основы адсорбционной техники/2-е изд. перераб. и доп.//М: Химия, 1984, 592с.
8. Radovic, L.R. Ed. Chemistry & Physics of Carbon. CRC Press, 2008, 30, 264 p.
9. Samonin, V.; Podvyaznikov M.; Nikonova V. et al. Sorbent materials, unit products and controlled adsorption processes / In Russian L.: SPb.:Nauca, 2009, p. 271.
10. Adsorption, adsorbents and adsorption processes in nanoporous materials/ Collective volume, Moscow, 2011, pp. 469-474.
11. Autosorb AS-1. AS1Win. Gas Sorption System. Operation Manual. Firmware: version 2.55. AS1Win Software: version 2.0 and newer. Quantachrome Instruments, 2008.
12. Петухова Г.А., Поляков Н.С., Лупашку Ф.Г. Оценка пористой структуры активных углей//Изв. РАН, серия хим. 1995, №10, с. 1934-1936.
13. Bingzheng, L. Characterization of pore structure and surface chemistry of activated carbons – A Review. In Salih, S. Ed. Fourier Transform - Materials Analysis. InTech, 2012, pp. 165-190. Available from: http://www.intechopen.com/books/fourier-transform-materials-analysis/ charaterization-of-porestructure-and-surface-chemistry-of-activated-carbons-a-review.
14. Cibotaru, S. Study of processes of activated carbon obtaining from wood charcoal. Chemistry Journal of Moldova, 2012, 7(2), pp. 93-97.

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PLANNING THE STAGES OF A LICENSE (BACHELOR) / MASTER THESIS WITH CLASSICAL METHODS OF GRAPH THEORY

BÎCLEA DIANA,
doctor of physics and mathematics
Cahul State University "Bogdan Petriceicu Hasdeu",
e-mail: biclea.d@gmail.com

Abstract: *This paper describes the process of planning the realization stages of a research thesis (license/master) and classical methods of graph theory are applied to the proposed ones. It is proposed a project model for planning the stages of realization of a thesis by using project management concepts, taking into account the requirements of the guide for the elaboration of a license/master thesis and methods of planning in applied mathematics (the Graph theory). In this paper the solution of the proposed problem was determined by the following methods: Gantt, Critical Path Method and PERT. It is advisable to run the research work for each method and the differences between methods.*

Keywords: *Project, CPM, PERT, the earliest time, the latest time, critical path, critical events, probability factor.*
UDC:378.2

The license (bachelor)/ master thesis is a research project, conducted by students or master students at the end of their studies. The paper represents the results of the candidate's skills and abilities during the years of study, being developed and applied using scientific research methods and intellectual capabilities.

Developing a license or master thesis is a difficult process when if it is not planned. It is very important to make a correct and clear planning in order to achieve the main purpose, the realization of a scientific research finalizing with a scientific work.

The failure to plan a license/master thesis project leads to an unpleasant end, the reason for not planning being the following : I do not have time; I have to finish the sentence faster, etc. If there is no plan there is no control of the stages of the plan.

It is proposed a project model for planning the stages of realization of a license/master thesis using project management concepts, taking into account the requirements of the guide for the elaboration of a license/master thesis and methods of planning in applied mathematics (graph theory).

Many economic situations involve the application of applied mathematics, namely the concepts of graph theories in project management. Not many economic activities can be accomplished without mathematical calculating tools.

A project is a work consisting of several activities that are carried out once and which has some established terms of initiation and financing, on a well-defined work area, a budget and a temporary team that will be dismantled when the work is over. All projects are limited by some performance, time, cost and domain requirements [4, p.26].

The phase of designing and implementing a project are [4, p.21; 14]:

1. The initiation phase is the beginning of the project. In this phase, the idea for the project is explored and elaborated. Concept of the project. Marketing's contribution and competence study.
2. Identify and define the project's problem. Development of a vision. Formation of the mission. In this phase, the requirements that are associated with a project result are specified as clearly as possible.
3. Project planning. Strategy development, implementation planning, risk control. In the design phase, one or more designs are developed, with which the project result can apparently be achieved.
4. Implementation and execution of the project. Control of the whole work. Making the necessary corrective action. Potential suppliers or subcontractors are brought in, a schedule is made, materials and tools are ordered, and instructions are given to the personnel and so forth.

5. Done. Final finishing touches. Concluding and evaluating the project.

The article involves going through of the 5 phases of a project with a comprehensive and detailed study in the project planning phase. The obtained is a scheme that a student has to pass in order to be able to plan the stages of the thesis in a successful and well-organized manner. At the same time, the importance of the interdisciplinary link between applied mathematics in the economy is indicated.

In order to carry out the proposed project, is the completion of a research thesis, either undergraduate or master, it is necessary to formulate a problem to be solved.

For a more successful approach of the proposed problem it is necessary to answer the basic questions of the design phase [4, p.24]: *What should be done? Who should do it? How should it be done? When should it be completed? How much does it cost? Through the life cycle of the project we will answer these questions.*

It is a matter of planning the stages of the execution of a thesis, to develop a license/master thesis. In order to solve this problem, the terms set by the conditions of the license/master thesis and the predefined times are taken into account.

The general activities and periods for the development of a license/master thesis are [9]:

1. Establishing the theme (the theme of the scientific leader is set or the student proposes a theme) 11.09-05.10.
2. Documenting and processing information 05.10-31.10.
3. Drawing up and approving the master thesis plan 01.11-08.11.
4. Elaboration and presentation of Chapter 1. 09.11-05.12.
5. Elaboration and presentation of Chapter 2. 06.12-11.01.
6. Elaboration and presentation of Chapter 3.12.01-01.03
7. Final presentation of the practical application. 02.03-30.03.
8. Preventive Presentation at the Department 25.04.
9. Presentation of the master thesis at the Chair with the opinion of the scientific leader 12.05.

The fixed periods are guidance periods and may vary from day to day. For each stage it is necessary to consider meetings with the scientific leader for any obtained result or any question related to the request process.

When preparing the plan, the candidate is the most responsible person in terms of the content and form of the work and should be permanently guided by the scientific leader.

For presentation of a project and for better organization, networks are used, these being arrows or bars. The project representation network is the tool used for planning, calendar scheduling, and monitoring the progress of project work. The network is constructed on the basis of the information gathered from the division by activity structure and is a graphical representation of the work plan of a project [1; 3, p119; 7].

A package of operations is defined independently of the other work packages, has defined start and end points, requires specific resources, involves technical specifications, and has its own estimated cost [1; 3, p.121].

The most known programming methods in project management using networks are:

1. Gantt's diagram or bar chart.
2. Critical Path Method method (CRM).
3. The PERT method (Program Evaluation and Review Technique) .

The end of the project will be the actual presentation of the thesis / master thesis, the evaluation being the mark obtained at the public presentation of the researched work.

Expenses related to the realization of the project depend on its field of researched. Generally, the cost is the lowest cost because it is a personal project and represents an initiation in the field of scientific research.

Considering the formal terms and periods established for achieving project milestones can develop activities to be covered. A reformulation of the above mentioned activities and a clearer presentation of the project are given in Table 1. Each activity has a duration calculated after the period established in the calendar for the elaboration of the Theses Union. Taking into consideration that the

process of realizing the thesis dates from October with the proposed research topics and according to the calendar, it finishes in May, the approximate number of days may be 239 calendar days [9].

Table 1: The activities and the duration of the stages of elaboration of the license / master thesis

Name of activities (Noting activities)	*Past mandatory activities*	*Duration (Days)*
1.Establishing the theme (A)	-	5
2. Selection and organization of information sources (B)	A	20
3. Research and analysis of selected bibliographic sources (C)	B	10
4. Defining the topic and writing the thesis (D)	B	
5. Establishing the objectives and elaborating the methodological framework for the application (E)	D C,E	10 8
6. Problem formulation and development of research tools (F)		
7. Chapter 1. Analysis and data processing (G)	F	5
8. Chapter 1. Comparison of Existing Results (H)	F	
9. Chapter 2. Establishing a theoretical support for the realization of Chapter 3 (I)	H,G	18 14
10. Chapter 3. Practical implementation of proposed research objectives (J)	I	22
11. Chapter 3. Theoretical description of the obtained results (K)	J	36
12. Drawing of the thesis with introduction and conclusions. Preventive Presentation (L)	K	35
13. Review of the thesis and final presentation of the thesis (M)		
14. Permanent meetings with the scientific coordinator (N)	L	21
	M	30
		18

We have some restrictions on chronological sequences of activities: we can not start some activities until the previous ones end.

Finding the way into a project allows us to determine the impact on it of a change in sphere or priority. It will know what activities will have a greater impact and what needs to be done to recover the lost time [4, p.61].

A Gantt chart, commonly used in project management, is one of the most popular and useful ways of showing activities (tasks or events) displayed against time. On the left of the chart there is a list of the activities and along the top there is a suitable time scale. Each activity is represented by a bar; the position and length of the bar reflects the starting date, duration and the ending date of the activity http [13].

This allows you to see at a glance [13; 3, p.169-176]:

1. What the various activities are.
2. When each activity begins and ends.
3. How long each activity is scheduled to last.
4. Where activities overlap with other activities, and by how much.
5. The start and end date of the whole project.

The Gantt chart (Figure 1) can be customized for each student/master, independent of the field of research, the periods of work can be modified.

The Critical Path Method (CPM) consists of determining the maximum path in a non-circuit oriented network [6, p.133]. This method determines the minimum time to complete the project after all activities have been completed.

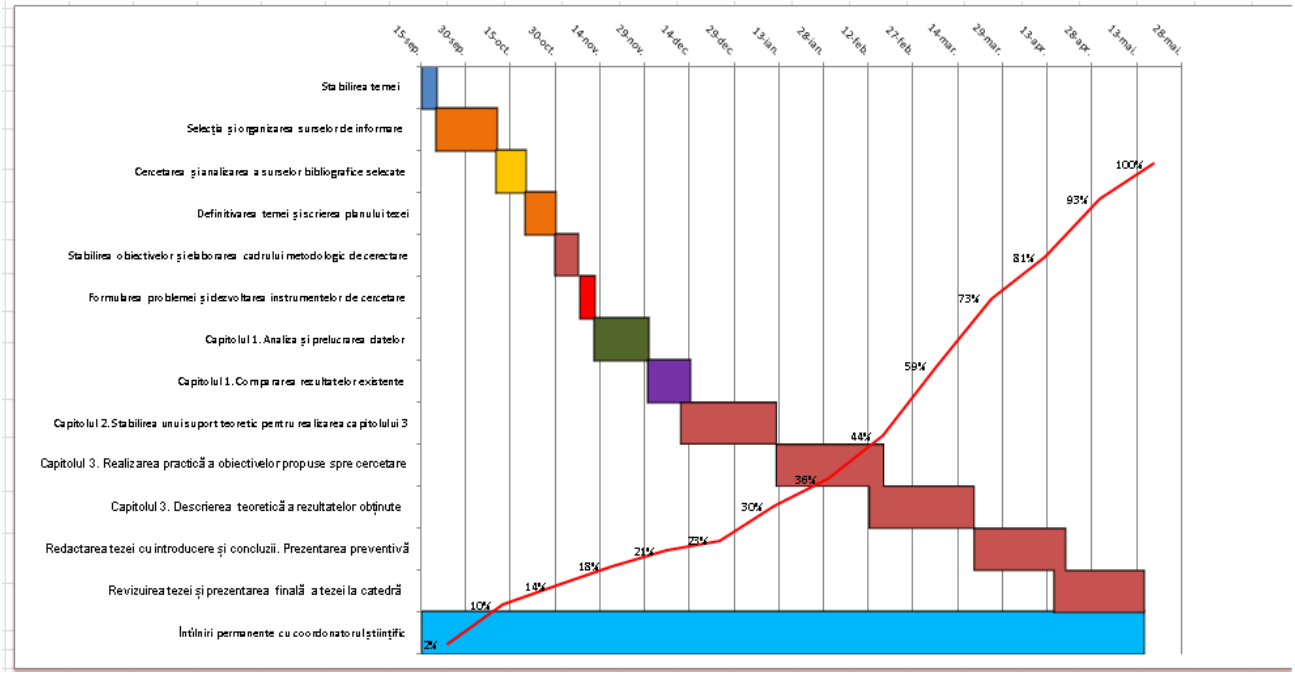

Figure 1: The Gantt chart

This method is very useful due its simplicity. It's based on the arrows network. We can define an arrow network as a graphical representation of a project which shows us the relationships between success and tasks. The main characteristics of this network are the graphics. Each activity is represented with a unidirectional segment, that is to say one arrow. This arrow has a beginning and an end determined for a node, usually drawing with a circle and also known as an event [10].

There is a situation of adding 2 value 0 activities that do not influence the determination of the critical road.

To represent the chart of activities in Table 1 or to restore the notations, the activities will be the arcs of the graph, the points that link the activities will be nodes. Activities I and J will be formal activities and will precede the activities H and G respectively. The new revolutions of the activities will be: I precede H, J precedes G, K precedes I and J, L precedes K, M precedes L , N precedes M, O precedes N and P precedes A (Figure 3). Fictive activities are activities I and J.

The graph representing the activities is a graphical graph (Figure 2) with 14 points and 16 arcs representing the activities.

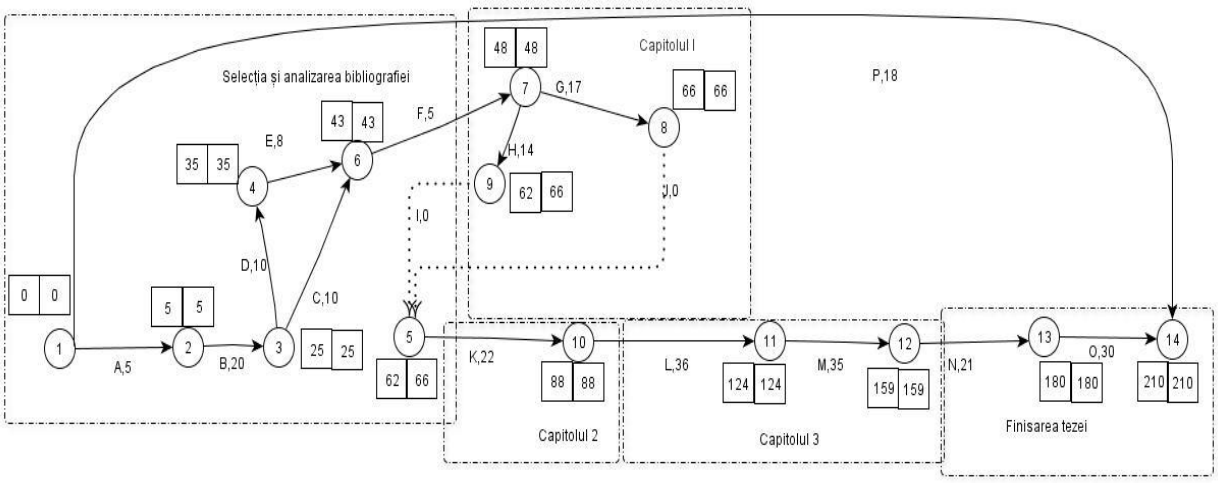

Figure 2: The activity graph given by the CPM method

Using the CPM method, the critical path of the critical events 1, 2, 3, 5, 4, 6, 7, 8, 10, 11, 12, 13, 14 was obtained by the sequence A-B-D-E-F-G-J-K-L-M-N-O. The estimated duration of the critical road is 210 days.

As we studied in the previous chapter, CPM method is a deterministic method. That means that it's necessary to know the approximately duration of the activities based on the experience and the available resources. But what happens when we can't determine the duration of the activity? P.E.R.T helps us in these cases. By means of this method we will be able to estimate some times for each activity for after calculating the probability of accomplishing it in the estimated dates. Therefore a difference of CPM, P.E.R.T. is a stochastic method based on the probability [10] .

The value of the different times that we will use in this method are based on the statistics information and the time estimation realized regarding to mathematics methods. The correct estimation of the times is very important to carry out the method in a right way [10].

This different times mentioned before will be three: Optimistic, pessimistic and more probable.

- t_o –optimistic time. It's the lower duration of one activity. It's the optimal time and it is reached if we don't have any setbacks.
- t_m - pessimistic time. It's the highest duration for one activity. We will reach this time in the worst case.
- t_p - more probable time or normal time. It will be the value that appears most often in a set of data with the same circumstances, the statistic mode.

The data with duration of time for corresponding the activity are in Tabale 2.

These estimates are calculated by averaging and dispersion, the errors being maintained within a normal distribution curve, characteristic of each type of project [15].

The next step is to calculate the estimated time regarding with the three times that we obtained. The estimated time is the weighted average of the three values. The definition of this time could be the time that we expect to finish the project. We will give more importance to the normal time so thereby the equation will be thereby [10,15]:

$$t_e = \frac{t_o + 4t_m + t_p}{6}.$$

Table 2: Activities of the PERT method

Name of activities (Noting activities)	*Past mandatory activities*	*Duration (Days)*		
		optimum	*probable*	*pessimistic*
1.Establishing the theme (A)	-	3	5	7
2. Selection and organization of information sources (B)	A	18	20	23
3. Research and analysis of selected bibliographic sources (C)	B	9	10	12
4. Defining the topic and writing the thesis (D)	B	5	10	12
5. Establishing the objectives and elaborating the methodological framework for the application (E)	D	5	8	9
6. Problem formulation and development of research tools (F)				
7. Chapter 1. Analysis and data processing (G)	C,E	2	5	6
8. Chapter 1. Comparison of Existing Results (H)				
9. Chapter 2. Establishing a theoretical support	F	17	18	22

for the realization of Chapter 3 (I)				
10. Chapter 3. Practical implementation of proposed research objectives (J)	F	13	14	16
11. Chapter 3. Theoretical description of the obtained results (K)	H,G	20	22	24
12. Drawing of the thesis with introduction and conclusions. Preventive Presentation (L)	I	35	36	40
13. Review of the thesis and final presentation of the thesis (M)	J	34	35	36
14. Permanent meetings with the scientific coordinator (N)	K	15	21	22
	L	20	30	31
	M	17	18	50

Having calculated this variable we will calculate the variance. The variance is a measure of how far a set of numbers is spread out. It is one of several descriptors of a probability distribution, describing how far the numbers lie from the mean (expected value). It's exactly what we want to know, how far our project to the expected objective is. We will define the variance as. The variance is the squared of the difference between latest time and the earlier time, all divided in to 36. We will get for all the activities [10,15]:

$$\sigma_e^2 = \frac{(t_p - t_o)^2}{36}$$

Average time and dispersion for the activities of Figure 2 are given in Table 3.

If an estimated project completion time T_f was considered, the PERT method includes the probability factor Z of framing the estimated duration of the critical road $T_e$in the term T_f [15]:

$$Z = \frac{T_p - T_e}{\sqrt{\sigma_p^2}}.$$

Table 3: Average duration and dispersion

Activity	t_e	σ_e^2
A	5	0,44
B	20,17	0,69
C	10,17	0,25
D	9,50	1,36
E	7,67	0,44
F	4,67	0,44
G	18,50	0,69
H	14,7	0,25
I	0,00	0,00
J	0,00	0,00
K	22,00	0,44
L	3,50	0,69
M	35,00	0,11
N	20,17	1,36
O	28,50	3,36
P	23,17	30,25

The graph of activities represented by the PERT method is given in Figure 3.

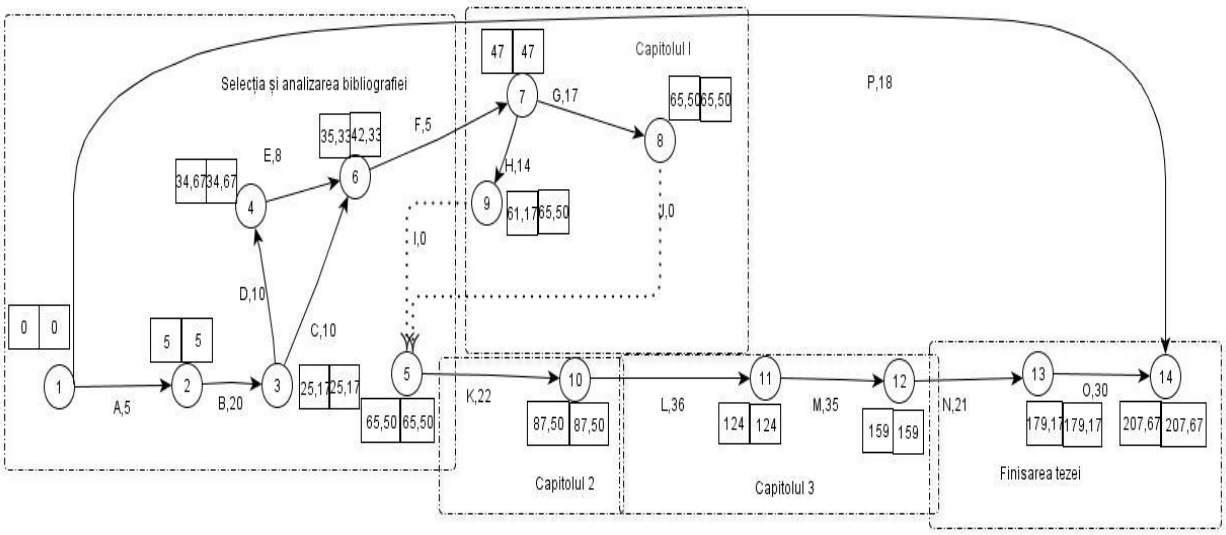

Figure 3: Activity graph using the PERT method

Using the PERT method, the critical path given by the ABDEFGJKLMNO sequence to critical events 1, 2, 3, 5, 4, 6, 7, 8, 10, 11, 12, 13, , And the total dispersion is 10.06.

Conclusions. Considering the estimated term $\mathbf{T_f}$ of finalizing the paper, the PERT method includes the calculation of the probability factor Z of the estimated duration of the critical road $\mathbf{T_e = 207,67}$ in the final term $\mathbf{T_f = 210}$ with a value of $Z = 0{,}735$ and the probability of completion of 75% .

The results obtained by both methods lead to the conclusion that a master / master work can be done in 207, 67 days minimum and 210 maximum days. With deviations of 10, 06 days. Following the diagram of Gantt (Figure 1) we can follow the realization process and the periods of realization.

This article is a good guide for graduates of the university studies in the elaboration of the research paper, it can also be consulted by the teachers for a better organization of the process of guiding the student in the scientific research.

REFERENCES:

1. Androniceanu, A., Comănescu, M., Sabie, O. *Managmentul proiectelor publice cu finanțare internațională* –B.:Ed. Universitară, 2010. 665 p. ISBN 9789737499929.
2. Mureşan, Anton S., Blaga, P. *Matematici aplicate în economie*. Editura: Transilvania Press, vol. 2, - C., N.: 1996. pag. 205, 279 p.
3. Buşe, F., Simionescu, A., Bud, N. *Managmentul proiectelor*.-B.: Ed. Economică, 2008. 426 p. ISBN: 9789737094049.
4. Chirleşan, D. *Gestiune proiectelor: teorie şi modele.*I.: Universitatea "A.I. Cuza", 2008. 398 p. ISBN: 9789737033659.
5. Ciobanu, G., Nica, V., Mustata F. *Cercetări operaționale cu aplicații în economie*: *Teoria grafurilor*. *Analiza drumului critic*. –B.: Matrix Rom, 1996. 208 p. ISBN: 9739254136.
6. Ciurea, E., Ciupală, L. *Combinatorică şi grafuri*. Bv.: 2003, 137 p.
7. Florescu Margareta, Marton Balogh, Neamțu Bogdana, Natalia Balogh. *Managementul proiectelor. Dezvoltare durabilă.* Suport de curs. Cluj-Napoca. 2011. 118 p, Disponibil: http://www.apubb.ro/wp-content/uploads/2011/03/Managementu-proiectelor_Dezvoltare_ durabila.pdf.
8. Neață, V. *Cercetări operaționale*. –S.:Ed. Universitară "L.Blaga" din Sibiu, 2004. 261 p. ISBN: 9736518485.
9. GHID privind elaborarea şi prezentarea tezei de licență/master. Universitatea de Stat "B.P.Hasdeu" din Cahul. 2013. p.16.

10. The Practice of Scheduling, Disponibil: hhttps://riunet.upv.es/bitstream/handle/10251/35292/diplomaprojectcarlosgonzalezperez.pdf?sequence=1.pdf.
11. http://web.rau.ro/mycourses/2004-2005/im_co/Curs-Grafuri-Drum%20Critic.pdf. (văzut 6.07.2017)
12. http://www.mpt.upt.ro/doc/curs/gp/Managementul_proiectelor/Cap3.pdf.(văzut .07.2017)
13. www.gantt.com/ (vizitat 6.07.2017)
14. https://www.projectmanagement-training.net/follow-up-phase/ (vizitat 06.07.2017).
15. http://www.mpt.upt.ro/doc/curs/gp/Managementul_proiectelor/Cap3.pdf (văzut .07.2017)

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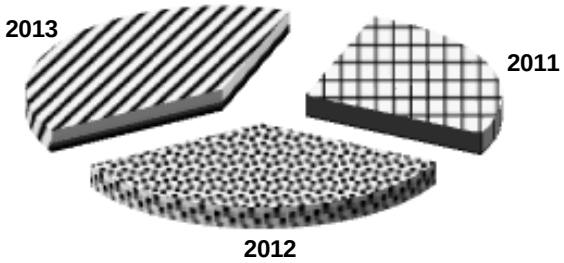

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