Actuarial multidimensional model of ukrainian agricultural companies' valuation

Yulia Manachynska
Department of Accounting and Taxation
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics
Chernivtsi, Ukraine
yu_manachynska@ukr.net

Olena Moshkovska
Department of Accounting and Taxation
Kyiv National University of Trade and Economics
Kyiv, Ukraine
M_Kulgeiko@ukr.net

Volodymyr Yevdoshchak
Department of Accounting and Taxation
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics
Chernivtsi, Ukraine
V_Yevdoshchak@ukr.net

Svitlana Luchyk
Department of Accounting and Taxation
Chernivtsi Institute of Trade and Economics of Kyiv National University of Trade and Economics
Chernivtsi, Ukraine
luchiksvitlana@gmail.com

Vasil Luchyk
Department of Economic Cybernetics, Information and Socio-Cultural Activities
Podilsk special educational and rehabilitation socio-economic college,
Kamyanets-Podilsky,Ukraine
luchik-vasil@ukr.net

Marharyta Luchyk
Finance, Banking and Insuring Department
Kyiv Cooperative Institute of Business and Law
Kyiv, Ukraine
Luchik-margarita@ukr.net

Abstract — **The article investigates the effect of actuarial balance on the results of valuation agricultural enterprises. The authors present an actuarial multidimensional model of agribusiness valuation, aimed at increasing the investment attractiveness of agricultural enterprises, taking into account the dichotomy of operating and financial activities. The assessment of actuarial balance sheets of agricultural companies was carried out and the method of adjusted net assets within the cost approach was used. Measures to further direct the attracted investments in the development of domestic agrarian business have been proposed.**

Keywords — **Actuarial model, valuation, investment attractiveness, agriculture.**

I. INTRODUCTION

The growing uncertainty caused by the corona virus (COVID-19) pandemic has had an unprecedented negative impact on countries and their business activity. The agro-industrial sector has already been damaged to some extent, as agricultural producers may also suffer losses, taking into consideration the sector's strong dependence on imported plant protection equipment (i.e. fertilizers and pesticides). Unstable market conditions have had a negative impact on a number of supply chains in the field of agricultural exports. Reducing the available workforce also remains a concern for agribusiness. The corona virus pandemic puts tremendous pressure on agricultural companies' performance results, which requires them to respond quickly to significant changes in altering conditions [1].

In 2020 the index of agricultural products amounted to 88.5% compared to 2019, i.e. the level of physical output of agricultural products decreased by 11.5%. For comparison purposes, the same figure in 2019 constituted 101.4%. In January-March 2020, large and medium-sized agricultural enterprises' losses amounted to UAH 156.4 million, meanwhile the share of unprofitable enterprises was up to 58.6% (of the total number of enterprises), which in absolute amount constitutes UAH 405.4 million. Respectively, the share of profitable ones was only 41.4% (UAH 249.0 million). That is, even before the start of quarantine in Ukraine until March 12, 2020 the agricultural sector had already experienced negative trends in the final efficiency of management. In January-June 2020 the level of loss reached UAH 188.4 million, and in the third quarter of 2020 (January-September 2020) the situation improved slightly and the absolute amount of damage decreased to UAH 135.1 million, but even such trends are negative compared to the same period (January-September 2019), when the absolute damage amount totaled UAH 43.3 million (i.e., it was UAH 91.8 million less than in the reporting period), herewith 50.0% of large and medium-sized agricultural companies were profitable, correspondingly 50.0% unprofitable.

Due to such tendencies agricultural companies must develop ways to increase the profitability of management, which, accordingly, requires an appropriate level of funding, and provides for the need to attract the necessary amount of investment. However, the real unprofitability of the agricultural sector forms a negative investment attractiveness image of the surveyed companies on the world stage of farmers through the prism of public financial reporting. Therefore, the question of using an objective accounting and information base by real and potential investors in the valuation of agricultural companies' cost, in our opinion, requires more attention in terms of transition to the current stage of accounting development, mainly actuarial one.

II. STATEMENT OF THE PROBLEM

Modeling potential investors' estimation of property usefulness and expediency of investing temporarily free financial resources in the development of an agricultural company is primarily determined by the procedure of agribusiness value assessment. Assessment is a set of logical procedures and calculations, the main purpose of which is to form a grounded conclusion about the company cost as well as its potential usefulness which the investor or the real buyer will receive on condition of agribusiness sale as a whole property complex (WPC) when investing appropriate funds.

It is known that the company cost is calculated by the formula:

$$CC = \sum_{t=1}^{n} \frac{FCF_t}{(1+r)^t},$$

where CC – is company cost

n - period for which there are forecasted values of cash flows;

r - discount rate, taking into account the risk and capital cost;

FCF_t – net cash flow that is available to the company during *t* period [2].

The task of an active investor is to maximize the amount of cash flows from investing – CFROI (Cash flow returns on investments). Assessing company cost is one of the most difficult issues of enterprise finance, in particular, the valuation of the company as a WPC. Valuation of an agricultural enterprise is carried out, as a rule, on the basis of market value – the probable amount of money for which it is possible to buy and sell the object of valuation on the market. The purpose of effective organization of property cost estimation is to choose the optimal valuation method for a particular object. In modern valuation practice, the following methodological approaches to assessment received the greatest prevalence:

- income method (cash flow discounting method; income capitalization method);
- cost method (replacement cost method; calculating net assets method; liquidation value method);
- comparative (multipliers contrasting method; transactions comparing method) [3].

It should be noted that none of the above methods within a specific methodological approach has significant advantages over others. However, in our opinion, the most appropriate method for agricultural companies' valuation procedure may be the cost approach, namely the method of net assets. The net assets method is based on the use of the company's traditional Balance Sheet (Financial Statement) as an information basis for valuing the company cost. Nevertheless, to our mind, it is advisable to replace this information base with a more innovative reporting form from the actuarial accounting system, namely – Actuarial balance sheet (Actuarial financial statement), which optimizes the valuation algorithm to one stage. The proposed actuarial model of valuation of an agricultural company is summarized by us in Fig. 1.

The actuarial valuation model (AVM) presented in fig. 1 demonstrates an alternative simplification of the net assets valuation procedure when used as an information basis for the Actuarial Balance Sheet (Actuarial Financial Statement), form №1-a. It should be noted that *the net assets valuation method* should be used to assess the existing agribusiness, because it is characteristic for agricultural companies to have a significant share of tangible assets in the structure of the Balance Sheet (including biological assets).

The advantage of *the net assets valuation method* is the use of information about real assets, i.e. it minimizes the factor of the appraiser's subjective opinion. Implementation of the companies' public financial statements as an information base for the valuation procedure allows you to estimate the entire composition of assets and liabilities used for calculation, which provides for the source data completeness [4]. However, the algorithm of the valuation procedure is quite time consuming. For its simplification we propose to use the actuarial management reporting in the valuation procedure as an accounting and information content, namely the form №1-a "Actuarial Balance Sheet (Actuarial Financial Statement)". As can be seen from fig. 1, the procedure for calculating the company cost (CC) is carried out in one step:

$$CC = NOA - NFL,$$

where NOA are net operating assets;

NFL – net financial liabilities.

This technique is determined by the statistical equation of actuarial accounting:

$$NOA = NFL + E,$$

where E is equity.

From fig. 1 it is also noticeable that the balance sheet equation of actuarial accounting determines the conceptual form of the Actuarial balance sheet (Actuarial financial statement), and differs significantly from the traditional balance sheet equation:

$$A = L + E,$$

where L are liabilities.

The disadvantage is that the net assets valuation method does not take into account the influence of markets. We are talking about both the markets for agricultural products in which the company operates, and the market where companies are sold (in the case when the purpose of assessment is to determine the selling price of agricultural companies).

The actuarial valuation model *(AVM)* provides for the interpretation of traditional financial reporting in 3D (forms №1, №2, №3) into 5D-actuarial format (forms №1-a, 2-a, 3-a). The 4D format equals 4D = 3D + t, (where t is time). Dots and vectors in 3D space with a definite coordinates system are defined by three coordinates; similarly, dots and vectors in 4D space have four coordinates.

Summation and subtraction of vectors is done gradually (component by component), as in the three-dimensional space. The scalar product of the 4D vector is determined by the formula:

$$a * b = a_1 * b_1 + a_2 * b_2 + a_3 * b_3 + a_4 * b_4,$$

As in the 3D case, the square root of the scalar square of the vector $a * a$ is its norm $\|a\| = \sqrt{a * a}$. The angle between the vectors is determined in the same way as for the 3D space:

$$\theta = \arccos \frac{a * b}{\|a\| * \|b\|}.$$

Unlike 3D, 4D space has no direct analogue of a vector product. You can use the bivector of the external product instead. Accordingly, the assessment processed according to actuarial reporting data forms a 5D-format = 4D + CC and helps to increase the investment attractiveness of the agricultural company in the foreign market. Thus, the main task of domestic agricultural companies is active implementation of actuarial reporting, which provides prompt and objective assessment of their cost (CC) for an investor.

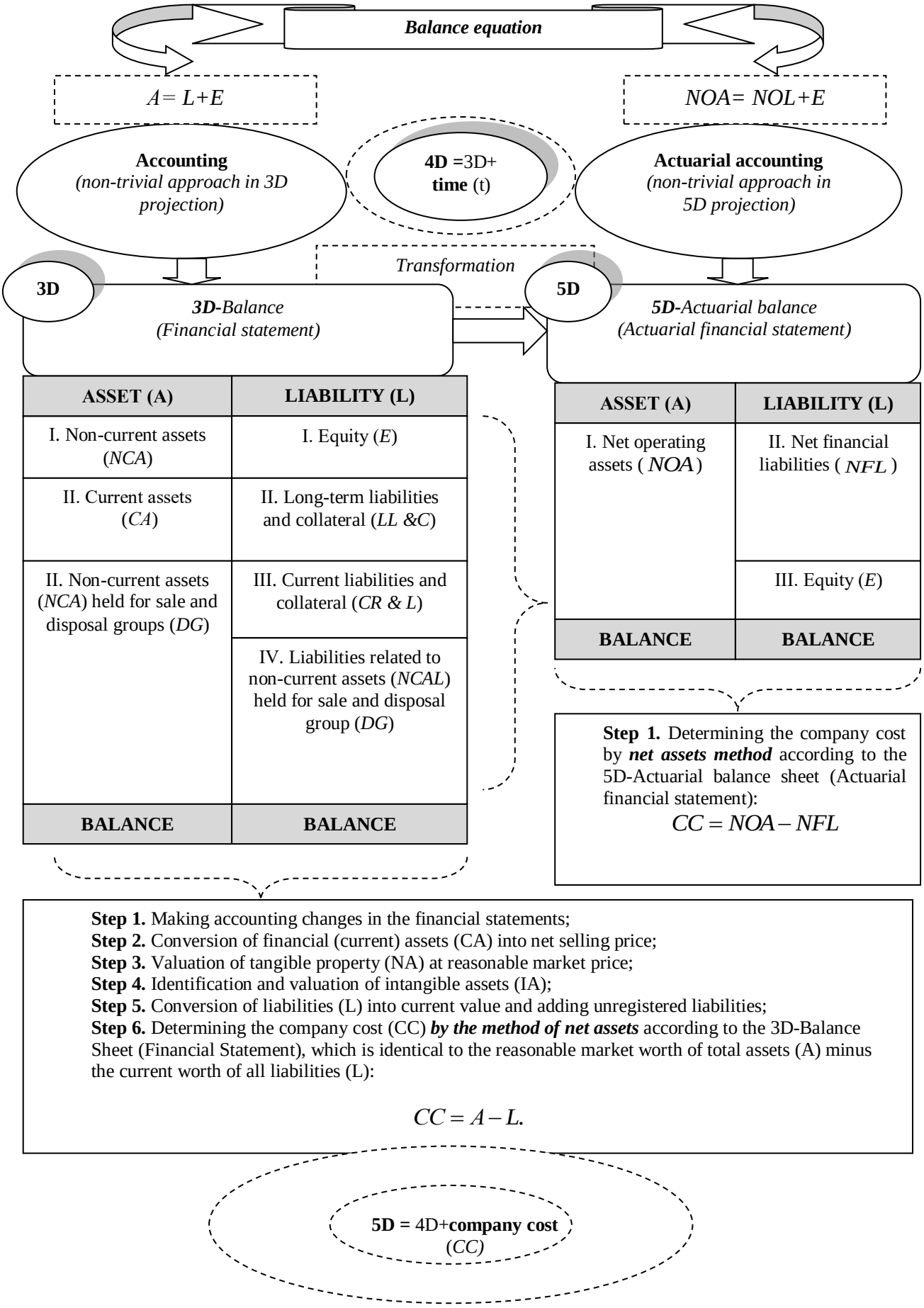

Fig. 1 *Actuarial model of the company cost valuation*

III. EMPIRICAL ANALYSIS

Let's analyze the balance indicators of Ukrainian agricultural enterprises for the 2016 – 2019 period to identify their actual structure and justify the effectiveness of the chosen net assets valuation method. Current assets take up the largest share in the assets structure of Ukrainian agricultural enterprises in 2016 – 2019 years, in particular in 2019. Their share is 62.21%, which is 3.59% and 23.57% less than the same figure in 2018 and in 2016 accordingly [5]. The most significant share of current assets was characteristic for 2016 and amounted to 85.78%, but during the study period it was decreasing from year to year. The equity share of Ukrainian agricultural companies in 2016 was scanty and amounted only to 24.03%, respectively 75.97% constituted long-term and current liabilities. However, in 2019 the situation improved and the equity share amounted to 50.74%, i.e. it increased by 26.71 % from 2016, and in 2017 it increased by 23.84% from the level of the base period, in 2018 – by 1.24%, in 2019 – by 1.63%, which should be noted as a positive trend in the growth of own sources of agricultural companies' financing. The total absolute amount of Ukrainian agricultural enterprises' net assets for 2019 amounted to UAH 522,778.7 million, which is UAH 39,800.00 million (or 8.24%) higher than the level of 2018 and UAH 153,407.8 million (or 41.53%) more than the same indicator in 2016.

For a more in-depth assessment of domestic agricultural companies' cost, let's analyze the dynamics of individual agricultural firms' net assets, such as Orshivska Agricultural Firm LLC, Berezivska Poultry Farm Agricultural Firm PJSC, Gunivska Agricultural Firm PJSC, S. Lazo Agricultural Firm PJSC. Assessment of the balance sheets asset structure of individual agricultural firms in Ukraine only confirms the trends characteristic for all domestic agricultural companies in relation to the largest share of current assets in their composition.

In particular, asset share in Orshivska Agricultural Firm LLC reached 98.5% in 2019, the share of tangible assets was slightly lower at Berezivska Poultry Farm Agricultural Firm PJSC – 93.11%, while at Gunivska Agricultural Firm PJSC and S. Lazo Agricultural Firm PJSC it constituted 64.74% and 66.81% respectively. For two companies (Gunivska Agricultural Firm PJSC and S. Lazo Agricultural Firm PJSC) the share of equity is significant – 94.25% and 86.30% respectively, which indicates that they finance their activities from their own sources of funding, and are independent from borrowed capital [6].

In its turn, Orshivska Agricultural Firm LLC has a rather small share of equity – only 19.14%, respectively its long-term liabilities account for 20.90% and current for 59.96%. Activity of Berezivska Poultry Farm Agricultural Firm PJSC for 2019 was unprofitable (the absolute amount of net loss amounted to UAH 788.90 million), which indicates a negative value of *net assets* in the reporting year at the level of UAH 774.59 million. Therefore, enterprises of the branch need adequate financing and attraction of the necessary investments volume [7; 8]. Also actuarial balances are considered in detail in the works of A. Billig, & J. Ménard, [10], M. Boado-Penas, S. Valdés-Prieto & C. Vidal-Meliá [11; 12]. To assess the value of the above-mentioned agricultural firms, we will transform their Balance Sheets (Financial Statements) into Actuarial Balance Sheets (Actuarial Financial Statements), using the method of A. I. Shigaeva [3] and apply valuation by the net assets method. The results are presented in table 1. Thus, at Orshivska Agricultural Firm LLC, Agricultural Firm named after S. Lazo PJSC and Berezivska Poultry Farm Agricultural Firm PJSC net financial liabilities (NFL) were formed, as the amount of financial assets was less than the amount of their financial liabilities, and at Gunivska Agricultural Firm PJSC net financial assets (NFA) were formed.

TABLE 1 Cost Valuation of Agricultural Firms by the Net Assets Method According to Data from Actuarial Balance Sheets (Actuarial Financial Statements) as of 01.01.2020.

Indicators of the Agricultural Firm actuarial balance	Orshivska Agricultural Firm LLC, village Orshivtsi, Kitsman district, Chernivtsi region, Ukraine	Gunivska Agricultural Firm PJSC, village Gunivka, Velykobilozerskyi district, Zaporizhia region, Ukraine	S. Lazo Agricultural Firm PJSC, village Nadrichne, Tarutyn district, Odessa region, Ukraine	Berezivska Poultry Farm Agricultural Firm PJSC, village Sadovoe, Baryshivskyi district, Kyiv region, Ukraine
I. Net operating assets				
Operating assets (*OA*)	476159,0	55967,0	36298,0	1285530,0
Operating liabilities (*OL*)	286893,0	3394,0	4895,0	938329,0
NET OPERATING ASSETS (*NOA=OA-OL*)	**189266,0**	**52573,0**	**31403,0**	**347201,0**
BALANCE	**189266,0**	**52573,0**	**31403,0**	**347201,0**
II. Net financial liabilities / Net financial assets				
Financial assets (*FA*)	2298,0	3022,0	20,0	100,0
Financial liabilities(*FL*)	100000,0	-	81,0	1121896,0
NET FINANCIAL LIABILITIES (*NFL=FL-FA*)	**97702,0**	-	**61,0**	**1121796,0**
NET FINANCIAL ASSETS (*NFA=FA-FL*)	-	**3022,0**	-	-
III. Equity / Cost of agricultural companies (by net assets method)				
Equity (*E*)/ Company cost (*CC=NOA-NFL*)	91564,0	55595,0	31342,0	-774595,0
BALANCE	**189266,0**	**52573,0**	**31403,0**	**347201,0**

Accordingly, the cost (CC) of the surveyed agricultural firms, according to Table 3 constitutes UAH 91564.0 thousand for Orshivska Agricultural Firm LLC, UAH 55595.0 thousand for Gunivska Agricultural Firm PJSC, UAH 31342.0 thousand for S. Lazo Agricultural Firm PJSC. Only for Berezivska Poultry Farm Agricultural Firm PJSC net assets are negative and amount to UAH 774595.0 thousand, which is due to its performance unprofitability. The absolute amount of loss for the reporting year amounted to UAH 788900.0 thousand. Consequently, out of the five surveyed agricultural firms, the largest amount of net assets was at Orshivska Agricultural Firm LLC, but a real and potential investor will probably choose and invest in Gunivska Agricultural Firm PJSC since however its net assets value is lower by UAH 35969.0 thousand, a positive feature is its actual absence of financial liabilities (FL).

IV. Conclusion

Thus, one of the main strategic directions for improving the efficiency of agricultural companies in Ukraine should be to create an attractive investment climate through the prism of accounting and information content of the actuarial reporting model. Actuarial reporting is based on the dichotomy (separation) of financial and operating activities of the company, which is useful for current and potential investors in making decisions about providing resources to this entity and meets the general reporting requirements of the Conceptual Framework for Financial Reporting. Investors' expectations regarding the profits of an agricultural company depend on their assessment of the rationality of economic resources management, as well as on an objective assessment of the net assets amount.

The proposed actuarial multidimensional model of agricultural companies' valuation will help increase the image of investment attractiveness of the Ukrainian agricultural sector, as it will provide current and potential investors, lenders and other creditors with accounting information that will help them make such estimates. In particular, it will inform about:

- net operating assets (operating assets; operating liabilities);
- net financial liabilities (financial assets; financial liabilities);
- the agricultural company cost;
-economic resources of an enterprise, requirements for the entity and changes in these resources and requirements;
- the efficiency and effectiveness of management and whether agricultural company administration has fulfilled its responsibilities for the use of economic resources.

When attracting foreign investment it is important, if not crucial to justify the direction of investment by areas of use. In modern conditions, the focus should be mainly on strengthening the material and technical base of agricultural companies, in particular on increasing the number of fixed assets of agricultural production [9]. After all, among the priorities for the agricultural production development an important place is occupied by: the introduction of high-performance technologies for growing crops and keeping cattle; output regulation of effective chemical means of animal and plant protection, updating and modernization of the processing and food industry enterprises on the basis of newest technologies; production of equipment for the butter and fat, meat and dairy, flour and cereal as well as baking industries; development of agricultural engineering, raw materials base for the production of containers and packaging materials.

References

[1] Y.Tereshchenko COVID-19: Impact on the food industry and agribusiness. Data. Available at: https://home.kpmg/ua/uk/home/media/press-releases/2020/04/vplyv-na-kharchovu-promyslovist.html

[2] S. Pupentsova "Fundamentals of Assets and Business Valuation", textbook. Allowance, SPb, Department of EiMNiT SPbSPU, 2011, 218 p.

[3] A.Shigaev "Actuarial accounting and the use of its data for management", Magistr, INFRA-M, 2011, 129 p.

[4] S. Stoyanova-Koval "Current assets of agricultural enterprises: economic essence and scientific and methodological approaches to the specifics of their classification", Scientific Bulletin of Uzhgorod National University. Issue 10. Part 2. pp. 100-105.

[5] V. Bechko "Formation and efficiency of use of working capital of agricultural enterprises", Uman, SPD Sochinsky, 2008. 136 p.

[6] Index of agricultural products in 2020 (preliminary data). Data. Available at: http://www.ukrstat.gov.ua/

[7] V. Evdoschak, Y. Manachynska "Actuarial basis of triple entry accounting system in the context of internal control perfection", Economic Annals-XXI, 2015, 1-2(2), pp. 67–70

[8] O. Fomina, O. Moshkovska, S. Luchyk, Y. Manachynska, M. Kuzub Managing the agricultural enterprises' valuation: Actuarial approach, Problems and Perspectives in Management, 2020, 18(1), pp. 289-301.

[9] Attracting foreign investment in agriculture of Ukraine. Data. Available at: http://referatss.com.ua/work/zaluchennja-inozemnih-investicij-v-silske-gospodarstvo-ukraini/

[10] A. Billig & J. Ménard Actuarial balance sheets as a tool to assess the sustainability of social security pension systems. 2013. Vol. 66, Issue, 2. April-June, 31-52 Data. Available at: https://onlinelibrary.wiley.com/doi/epdf/10.1111/issr.12008

[11] M. Boado-Penas, S. Valdes-Prieto, and K. Vidal-Melia. Actuarial balance for financing for payment. Fiscal Studies, Vol. 29, No. 1 (March 2008), pp. 89-134. Data. Available at: https://www.jstor.org/stable/24440167?seq=1

[12] The role of the Actuarial valuation report in plan funding. February 28, 2013. Data. Available at: https://www.gfoa.org/materials/the-role-of-the-actuarial-valuation-report-in-plan