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Economics

Approach for Predicting Index of Security with the Own Current Assets according to the Capital Structure of Commercial Organizations of the Republic of Armenia

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In the paper, we primarily aimed to build a behavioral approach for prediction of index of security with the own current assets according to the capital structure by using data from commercial organizations of the Republic of Armenia. The model built and optimized on the basis of training data, calculates the loss function during the program activity. Mean Square Error was chosen as a loss function. The goal of the gradient reduction method is to minimize the loss function. On the basis of the prediction model built, correct solutions were predicted for those organizations where cases of not being secured by own current assets were observed. They fully comply with the theoretical and practical decisions made within the scope of the conceptual provisions of financial management.

Theory, capital, current assets, value

The first theory on the formation of capital structure was given by J. Williams in the 1940-1950s [1]. D. Durand [2:215-262], F. Modigliani and M. Miller [3] also put forward their theories on the capital structure of organization by laying the first foundations for the financial management of capital structure. Within the scope of theoretical and methodological issues, the most important theories for formation and optimization of capital structure are the Modigliani – Miller, traditional, agency costs, asymmetric information, mutually agreed, statistical and hierarchical theories.

In this paper we have emphasised the signaling models significant in the process of capital structure optimization, which convey the investors necessary signals on the capital market. In this regard, Rocca's [4: 107-130] approach is well-known, which provides that the top management team of the organization may use capital structure as a signal for the external investors based on which the latter receive information on the perspectives of the development of the organization. The model proposed by this researcher enables us to conclude that the increase in debt burden of the organization

will be evaluated as an important signal of financial stability of the organization and an increase in expected cash flows, which will make it possible to service its debt obligations. In our opinion, the increase in the debt burden of the organization cannot be infinite, it must be within the permissible limits of the predetermined financial risk.

In order to receive signals for distribution of asymmetric information on capital structure of the organization H. Leland and D. Pyle proposed their model, which highlights the following conclusions [5: 371-387]:

- The investor's desire to invest its own assets in the investment program is viewed by the financial market as a positive signal.
- The higher is the risk of the investment program, the lower is the level of debt burden.

Growth of the debt burden of the organization is viewed in the market as a positive signal for the quality of investment programs, as well as for the desirable level of financial stability of the organization.

Factually, the signaling theory, like the hierarchical theory, is based on the presumption of availability of asymmetric information in the capital market. However, if the hierarchical theory emphasizes the negative connection between the financial leverage and profitability of the organization, the signaling models demonstrate that the higher is the organization's profitability, the higher is the value of the financial leverage.

In line with the scientific and technical progress, nowadays, the preferred research areas are the construction of dynamic signaling models and the development of such complex models that make it possible to combine the essential principles of individual theories of the capital structure.

Within the framework of modern theories of the capital structure, the importance is attached to the behavioral models which are developed on the basis of the principle of behavioral manifestation of participants of the market. D. Kahneman and A. Tversky proposed the theory of perspectives and substantiated that manifestation of negative behaviour of an individual results from misunderstanding and misevaluation of information [6: 278].

Within the scope of the behavioral theory of capital structure, three main directions have emerged. They are:

- Market timing theory.
- Information cascade theory.
- Theory of the influence of top management team characteristics.

The most well-founded of the above-mentioned theories is the market timing theory, which is based on the financial decisions made on the state of the financial market [7: 272-306].

On the basis of the data of G7, A. Mahajan and S. Tartaroglu demonstrated the inverse dependence of statistical significance between the market and balance sheet values of financial leverage and assets [8: 754-766]. As a result, they found out that the capital structure in the large organizations of the United States, France, Canada and the United Kingdom changes in the case of additional issue of securities; the impact of adherence to the capital market is short-term and is neutralized in a maximum of five years.

The theory of information cascades has been studied by S. Bikhchandani, D. Hirshleifer and I. Welch [9: 151-170]. According to them, an optimal strategy for manifestation of an individual's behaviour is the recurrence of actions or decisions of his or her predecessors who appear in such situations irrespective of the personal information they obtain. Within the framework of information cascade theory, the formation of capital structure of the organization is carried out by assessing the impact of the branch debt burden as a factor (from the statistical indicators – the median, the mean) on the financial leverage of the organization.

The theory of the influence of top management team (TMT) characteristics is based on the assumption that when making decisions on the

formation of capital structure during the management process, there may be behavioral deviations under the influence of internal and external factors. In particular, the research made by L. Barros and A. Silveira revealed that overconfidence of the top management team has a direct influence on the organization's financial leverage [10].

In theoretical and practical terms, all three directions of the behavioral theory of capital structure are important, however, in order to improve the efficiency of financial decision-making, it is appropriate to combine them with the synthesis of several other approaches.

Given the importance of the issue and the situation caused by Covid-19, we have developed and offer an approach for predicting own current assets according to the capital structure of the organization. It should also be noted that within the framework of the anti-crisis management directed to overcome the economic consequences of Covid-19, each commercial organization needs to revise the requirement for security with their own current assets and find solutions to cover the existing deficit. The description of the model developed within the scope of our approach is presented below.

Main Variables of the Neural Network

In order to predict the variable Y1 (the index of security with own current assets in percentage) from the variables P1-P5 (P1 is the share of own capital in total liabilities; P2 is the share of long-term loans and borrowings in total liabilities; P3 is the share of short-term loans and borrowings in total liabilities; P4 is the share of commercial and other accounts payable in total liabilities; P5 is the share of other stable liabilities in total liabilities), a deep neural network is formed using TensorFlow package, which has the following structure: 5 – 5 – 10 – 20 – 10 – 5 – 1. Thus, there are five layers placed between five input neurons and one output neuron, the neural composition of each of which is presented above. The activation function of each layer is sigmoid; the value of the output signal of the kth neuron placed in the middle layer is determined by:

$$\phi_k(x) = \frac{1}{1+e^{-x}}, \quad (1)$$

where:

$$x = \sum_{i=1}^{m} w_{kj} x_j, \quad (2)$$

m is the number of neurons in the proceeding "input" layer, x_j is the output signal of the jth neuron in that layer, w_{kj} is the weight corresponding to $j \rightarrow k$ connection.

During the training, the problem of weight optimization is solved through the gradient reduction algorithm [11]. The model built and optimized on the basis of the training data calculates the loss function during the program activity; Mean Square Error was chosen as a loss function. The goal of the gradient reduction method is to minimize the loss function. The test data do not participate in the model optimization process, that is in reducing the loss function. However, after each iteration, the test data enter the improved model, and the output result of the model is therefore compared with the relevant value of the test data. Thus, the applicability of the model for data other than the training data is also checked.

Input Data

The first five columns of Table 1 show the structural components of capital of a particular organization; P_1–P_5 are the input variables of the first layer of neural network. The corresponding real target Y_1 variable is presented in the 6th column, and the predicted outputs of the model obtained as a result of the training process are presented in 7th column. Column 8 shows the absolute values of the relative error in percentage.

Table 1. Statistical information on the model training process

Reference Number of the Organization from the Inquiry	P_1	P_2	P_3	P_4	P_5	Y_1	Y_1 predicted	RelAbsErrY1 in %s
41	23.07002	60.31283	12.15007	4.112093	0.35499	67.21547	67.2122421	0.004795895
14	47.15995	38.69142	1.04204	6.90921	6.197381	76.52458	76.5237503	0.00108002
78	19.19024	29.08026	14.66016	29.81476	3.689752	28.05721	28.0571747	0.000112069
65	75.59877	10.54795	4.344825	8.788	0.720452	74.18181	74.1796875	0.002858301
1	16.82744	64.64867	0.354777	17.60944	0.207236	73.46364	73.4609985	0.003593413
22	75.59877	10.54795	4.344825	8.788	0.720452	74.18181	74.1796875	0.002858301
68	26.84058	9.335299	24.88928	14.26008	24.4285	22.59535	22.5908279	0.020023992
35	19.19024	29.08026	14.66016	29.81476	3.689752	28.05721	28.0571747	0.000112069
39	16.82744	64.64867	0.354777	17.60944	0.207236	73.46364	73.4609985	0.003593413
42	73.14113	4.838227	0.574367	21.21085	0.019311	39.66018	39.6554947	0.011826223
0	28.61358	57.93813	0.362885	12.6426	0.192007	82.72778	82.7251129	0.003229848
61	30.39237	55.34332	6.594781	7.651183	0.002048	74.3585	74.3505173	0.010734667
3	73.14113	4.838227	0.574367	21.21085	0.019311	39.66018	39.6554947	0.011826223

Table 2. Test results of the model

Reference Number of the Organization from the Inquiry	P_1	P_2	P_3	P_4	P_5	Y_1	Y_1 predicted	RelAbsErrY1 in %s
25	26.8406	9.3353	24.889	14.2601	24.429	22.6	22.5908279	0.020023992
2	23.07	60.313	12.15	4.11209	0.355	67.22	67.2122421	0.004795895
54	47.1599	38.691	1.042	6.90921	6.1974	76.52	76.5237503	0.00108002
19	30.3924	55.343	6.5948	7.65118	0.002	74.36	74.3505173	0.010734667

Table 3. Predictions for randomly tested commercial organizations

	P1	P2	P3	P4	P5	Y1 actual	Y1 predicted	year
Good Group (International) Limited	45.76	14.8	1.73	2.15	13.87	48.38	28.91765	2011
Good Group (International) Limited	46.47	20.98	2.62	0.28	20.11	55.66	29.14452	2010
“Telcell” CJSC	33	8.33	1.64	1.31	53.81	-20.75	32.23374	2013
“Telcell” CJSC	19.55	5.99	26.21	2.48	42.76	-86.6	25.63007	2012
"Spayka" LLC	41.15	47.49	5.33	0.042	0.98	48.29	30.57409	2018
"Spayka" LLC	40.43	40.16	6.25	0.11	6.21	17.47	30.08908	2017
“Armenian Copper Programme” CJSC	22.92	62.63	9.83	0.51	1.14	26.18	33.7935	2012
“Armenian Copper Programme” CJSC	32.49	15.74	45.55	0.88	2.54	-126.04	19.6303	2011
“Mrgashen Wine-Brandy Factory” LLC	25.14	0.0001	10.76	9.39	10.76	25.14	28.10073	2015
“Mrgashen Wine-Brandy Factory” LLC	68.71	0.0001	0.0001	12.3	18.97	68.71	21.65747	2016
"Renco ArmEstate" LLC	30.2	28.15	21.88	0.0001	19.75	54.73	26.09355	2016
"Renco ArmEstate" LLC	31.16	25.48	18.8	0.0001	24.54	53.26	26.93446	2015
“Narim” LLC	24.87	58.15	9.16	3.9	3.74	10.87	32.56292	2018
“Narim” LLC	16.71	51.97	11.49	6.18	13.63	5.63	32.8634	2017

The test data not involved in the weight optimization process, are separated from the main data set. Table 2, which contains the training and test results of the model, shows that the maximum relative error of the model is 0.02%.

In the process of improving the behavioral theory of capital structure, the data generated from randomly chosen commercial organizations tested on the basis of our approach are presented in Table 3.

On the basis of the prediction model built within the scope of the proposed approach, the data in Table 3 show that correct solutions have been predicted for those organizations where cases of not being secured by own current assets have been observed. It fully complies with the theoretical and practical decisions made within the scope of the conceptual provisions of financial management.

ეკონომიკა

საკუთარი მიმდინარე აქტივების უსაფრთხოების ინდექსის პროგნოზირების მიდგომა სომხეთის რესპუბლიკის სავაჭრო ორგანიზაციების კაპიტალის სტრუქტურის მიხედვით

ხ. ბაბოიანი

სომხეთის რესპუბლიკის მეცნიერებათა ეროვნული აკადემია, მ. კოტანიანის ეკონომიკის ინსტიტუტი

(წარმოდგენილია აკადემიის წევრის ვ. პაპავას მიერ)

წინამდებარე ნაშრომის მიზანია, სომხეთის რესპუბლიკის სავაჭრო ორგანიზაციების მონაცემების გამოყენებით, შევქმნათ კაპიტალის სტრუქტურის შესაბამისად საკუთარი მიმდინარე აქტივების უსაფრთხოების მონაცემების პროგნოზის ქცევითი მიდგომა. სწავლების მონაცემებზე დაყრდნობით შექმნილი და ოპტიმიზირებული მოდელი პროგრამის მუშაობის დროს ახორციელებს დანაკარგების ფუნქციის გაანგარიშებას, როგორც დანაკარგის ფუნქცია ჩვენს შემთხვევაში არჩეულია საშუალო კვადრატული შეცდომა. გრადიენტის დაწევის მეთოდის მიზანიც არის დანაკარგის ფუნქციის მინიმალიზება. შექმნილი მოდელით სწორი გადაწყვეტილებებია პროგნოზირებული იმ ორგანიზაციებისთვის, რომლებშიც არის საკუთარი მიმდინარე აქტივების არქონის შემთხვევები. ისინი მთლიანად შეესაბამება ფინანსური მართვის სტრატეგიის დებულებების ფარგლებში ნაჩვენებ თეორიულ და პრაქტიკულ გადაწყვეტილებებს.

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