FORECASTING TECHNOLOGIES FOR THE LABOR MARKET DEVELOPMENT

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Abstract
In this paper it is considered the technology for forecasting the number of graduates of vocational schools in order to further compare them with the needs of the labor market. And authors suggested use it for forecasting and calculating the rate of capacity building of the industry. The main factors influencing the decisions on the admission of entrants to secondary vocational education institutions were identified through a questionnaire. There is a justified need to promote the social status of the system of secondary vocational education, including by strengthening public relations in this direction, work with the media, etc.

Key words: *labor market, forecasting, supply and demand, strategic planning*

JEL Classification: *F22, F6*

I. INTRODUCTION

Today, one of the significant problems in many countries is the desire of almost all school graduates to receive higher education, due to which there is a shortage in the labor market of workers who are trained in vocational schools. The analysis of modern sources gives grounds to state that vocational education in Ukraine is currently in a difficult position. Its renewal and development at the present stage is complicated not so much by the imperfection of the legal framework as by the prolonged crisis in the state economy and non-compliance with the current rules of law in terms of financial support of vocational and technical institutions and educational institutions. These factors determine the negative trends and cause crises and problems in the system of vocational education. However, to predict and calculate the rate of capacity building and the need to increase or decrease the number of vocational education institutions, it is necessary to predict the dynamics of the number of vocational graduates, compare them with labor market needs, determine reserves for contingent preservation, student motivation technology, responsibility.

II. ACTUAL SCIENTIFIC RESEARCHES AND ISSUES ANALYSIS AND THE RESEARCH OBJECTIVE

Modern scientists (Batechko, 2004; Pashko, Kovalenko & Simonenko, 2015; Czyżewski & Polcyn, 2016) and others in their works cover issues of the education system development in Ukraine. In the works of scientists (Pavlova & Maclean, 2013; Bowskill, 2012; Shubenok, 2016). the competitiveness in the labor market of graduates of vocational schools is studied. Quite a large number of scientific works, in particular the works of Shmygol, Galtsova, Solovyov, Koval & Arsawan, 2020; Sysoieva & Sokolova, 2010; Herliand, 2013 are devoted to the study of the quality of education, education, educational process in theoretical, methodological and methodological aspects.

However, many questions about modern technologies and areas of vocational education development from the standpoint of economics, including student motivation, justifying the effects and benefits of vocational education, calculating the estimated number of graduates of vocational education institutions with further comparison with labor market needs, and implementation in vocational education institutions, the latest resource-saving technologies, unfortunately, are insufficiently studied.

Therefore, we propose a solution to this problem by introducing technologies for forecasting the number of graduates of vocational schools, supporting them by identifying the directions of motivation of students to enter vocational schools, which can then be used to compare the number of graduates with the market needs, and to forecast and calculate the rate of capacity building of the industry.

III. TECHNOLOGIES FOR FORECASTING THE NUMBER OF GRADUATES OF VOCATIONAL SCHOOLS.

The most common methods of forecasting socio-economic phenomena today are methods that are based on the prolongation of existing trends in the future. Such methods are called quantitative methods of predictive extrapolation. Prerequisite for the use of these methods is the assumption that the changes that have taken place with the object of study in the past, give a fairly good approximation in the assessment of its future state, due to the inertia of socio-economic phenomena.

Indeed, if the state of such a dynamic socio-economic system is not in close proximity to the point of catastrophe, when minor external influences can lead to a sharp, abrupt transition of the system to a completely different state, the process of its development over time can be considered inertial. The nature of the inertia existence is the presence of lag delays in the control system of any socio-economic system.

Studying vocational education as a component of the educational space of Ukraine, the urgent task that needs to be solved in this study is to forecast its state for the future. The main indicators for the development of vocational education, according to the State Statistics Service of Ukraine, are given in Table. 1.

Table 1. Vocational institutes for 2000-2019 (at the beginning of academic year)

Year	Number of institutions	Number of students, thousands of people	Accepted students, thousands of people	Trained (graduated) skilled workers, thousands of people
2000	970	524,6	307,3	266,8
2001	965	512,3	309,1	278,8
2002	962	501,9	311,0	282,4
2003	953	493,1	311,2	275,6
2004	1011	507,3	327,6	283,4
2005	1023	496,6	314,2	286,6
2006	1021	473,8	303,7	289,3
2007	1022	454,4	299,2	285,1
2008	1018	443,6	288,1	269,6
2009	975	424,3	249,9	239,4
2010	976	433,5	282,9	247,4
2011	976	409,4	241,7	240,1
2012	972	423,3	241,8	202,1
2013	968	391,2	225,2	227,3
2014	814	315,6	178,0	182,0
2015	798	304,1	176,6	165,0
2016	787	285,8	157,9	152,8
2017	756	269,4	146,9	141,3
2018	736	255,0	136,6	133,5
2019	723	245,8	131,0	124,0

Source: developed by the authors

Graphic representation of the number of accepted students and graduated skilled workers during 2000-2019 gives a more complete picture of current trends in the development of vocational education in Ukraine, Figure 1.
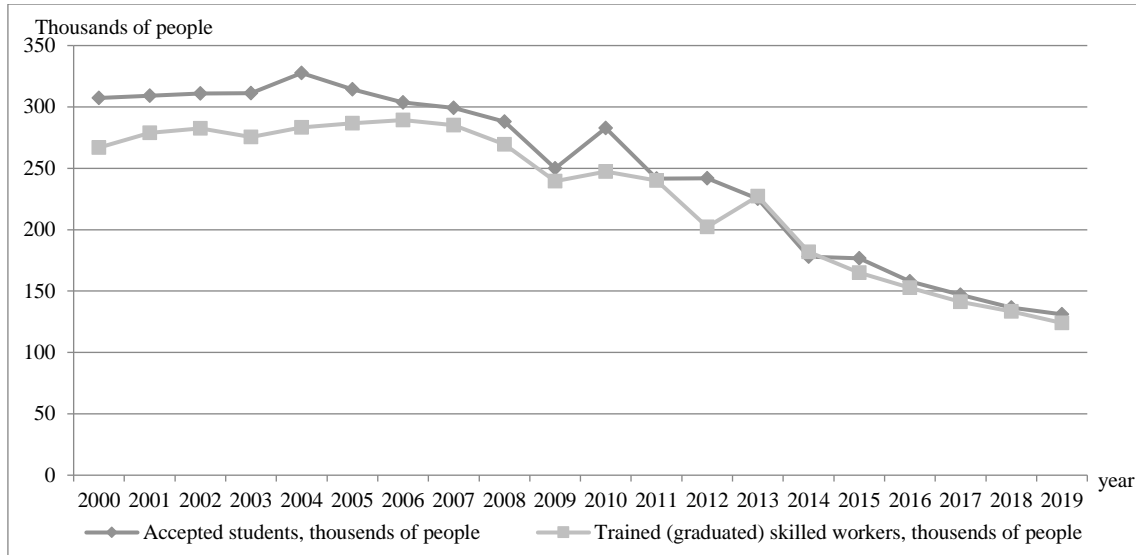
Figure 1 – Dynamics of accepted students and graduated skilled workers of vocational schools
Source: developed by the authors

The relative stability of the admitted number of qualified skilled workers in vocational schools at the level of about 270-300 thousand people during 2000-2006 has changed in the last decade with a negative dynamics of these indicators. This has led to the fact that the number of vocational school students has more than halved: from 524.6 thousand people in 2000 to 245.8 thousand people in 2019. This decrease occurred against the background of a reduction since 2008 in the number of educational institutions from 1018 to 787. Thus, it can be argued that vocational education is experiencing a period of crisis. Moreover, the reduction affected not only the contingent of students, but also the teaching staff and material and technical base. This, in turn, makes it impossible to quickly restore of the educational potential in this area, if necessary.

The result of the application of quantitative methods of predictive extrapolation, in particular, the method of least squares to construct a linear and polynomial dependence of the number of graduated skilled workers on time, is shown in Figure 2.
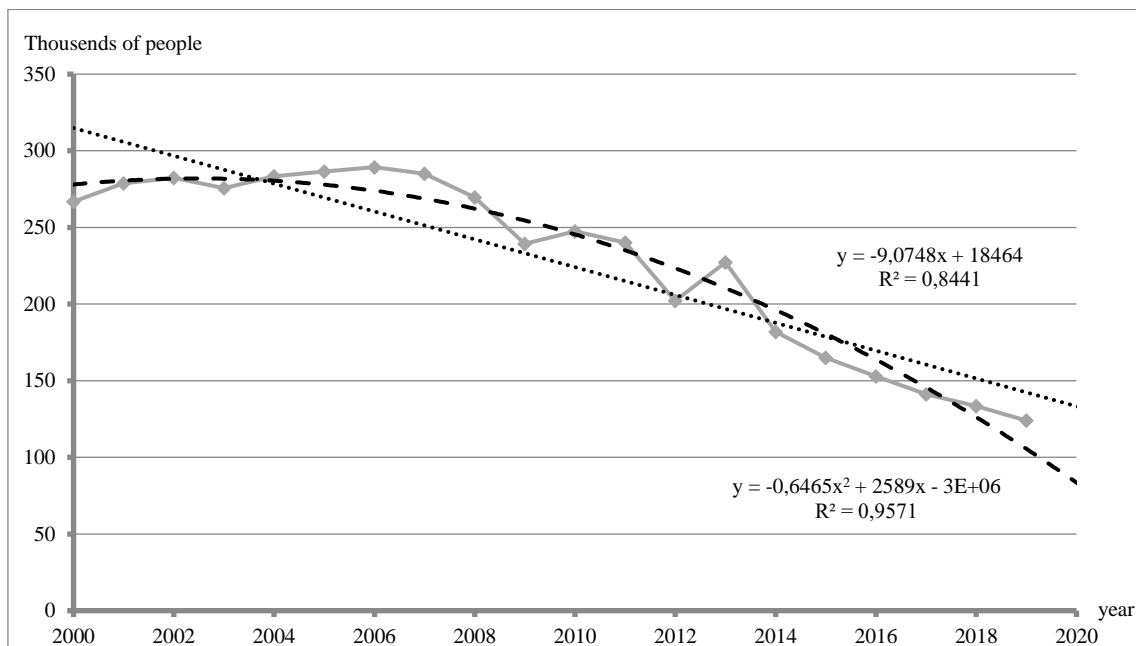

Equations shown in Figure 2:

$$y = -9{,}0748x + 18464$$
$$R^2 = 0{,}8441$$

$$y = -0{,}6465x^2 + 2589x - 3E{+}06$$
$$R^2 = 0{,}9571$$

Figure 2 – Forecasting the number of skilled workers by linear and polynomial approximation
Source: developed by the authors

For a linear forecast, use the model:

$$Y = -9,0748x + 18464 \qquad (1)$$

Where B - the number of graduated skilled workers of vocational institutes;
x - the year for which the calculation is performed.

As can be seen from Fig. 2, the reliability of the linear approximation of R2 is 84.41%. The equation of the line well describes the general trend of the studied phenomenon, however, the deviations of individual observations from the calculated values are quite significant.

To predict the polynomial curve of the second order should use the model:

$$Y = -0,6465x^2 + 2589x - 3 \times 10^6 \qquad (2)$$

In this case, the reliability of the linear approximation R^2 is quite high and equals to 95.71%. This means that the variation of individual values of observations from the calculated level does not differ significantly. Therefore, among the above equations, the dependence (2) is more adequate to the input data, so to predict the values of the target indicator it should be chosen.

However, if we predict the number of graduates of the vocational institutes according to this equation, then in the next 5 years it should be reduced almost completely, which is not true. Thus, according to statistics for the last 15 years, the share of those who graduated from secondary school (grade 9), received a certificate of basic general secondary education and continued their education in school of grade III (grades 10-11) in order to obtain a certificate of complete general secondary education, does not exceed 65%. That is, almost 35% of graduates leave school after the 9th grade. Of these, 94.5% of entrants enter vocational institutions to obtain a complete secondary education and obtain the qualification level "Skilled Worker" in a particular profession. Thus, the demand for services of the vocational institutes in the coming years may not disappear completely.

Thus, forecasting socio-economic phenomena only on the basis of existing development trends, without taking into account their complex structure and relationships between primary and derived indicators, may not always lead us to adequate research results.

That is why the specifics of the problem situation should determine the scope of a particular research method. For example, in demographic statistics, the most accurate method is used to predict the population - the method of age movement. The essence of this method is that having data on the population by individual age groups and using the probabilities of survival to the next age, you can consistently determine the population in the future, taking into account different birth rate scenarios. Thus, the current structure of the population is a key factor influencing its future amount. Given the above, in this study the author proposed practical recommendations for adapting the method of age movement to forecast the number of graduates of vocational institutions, the stages of which are schematically shown in Figure 3.
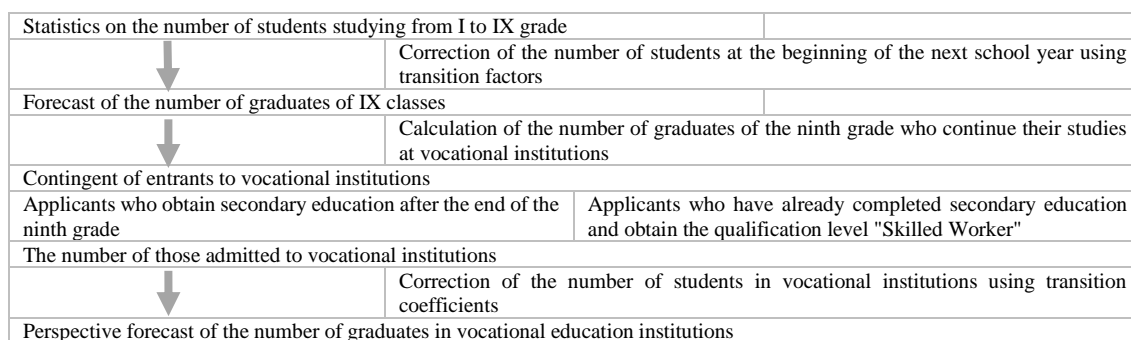
Statistics on the number of students studying from I to IX grade	
↓	Correction of the number of students at the beginning of the next school year using transition factors
Forecast of the number of graduates of IX classes	
↓	Calculation of the number of graduates of the ninth grade who continue their studies at vocational institutions
Contingent of entrants to vocational institutions	
Applicants who obtain secondary education after the end of the ninth grade	Applicants who have already completed secondary education and obtain the qualification level "Skilled Worker"
The number of those admitted to vocational institutions	
↓	Correction of the number of students in vocational institutions using transition coefficients
Perspective forecast of the number of graduates in vocational education institutions	

Figure 3 – Stages of long-term forecasting of the number of graduates of the vocational institutes
Source: developed by the authors

According to statistics, Table 2, the contingent of entrants to vocational institutions consists of two groups of persons:

Table 2. The number of students of the vocational institutes for 2010-2019

Year	Students of the vocational institutes who obtain the educational and qualification level "Skilled Worker"	Students of the vocational institutes who obtain secondary education
2010/11	175,6	257,9
2011/12	152,5	256,9
2012/13	151,9	271,4
2013/14	148,1	243,1
2014/15	122,4	193,2
2015/16	117,9	186,2
2016/17	106,8	179,0
2017/18	92,3	177,1
2018/19	83,4	171,6
Total	1150,9	1936,4

Source: developed by the authors

Applicants who complete secondary education after 9th grade - the largest group of entrants, their share is 1936,4 / (1150,9 + 1936,4) = 0,627 (62,7%);

Applicants who have already completed secondary education and obtain the qualification level "Skilled Worker" - their share is 1150,9 / (1150,9 + 1936,4) = 0,373 (37,3%).

The number of entrants in the second group depends on many factors and is difficult to predict. Therefore, in the framework of this study it is proposed to use scenario modeling to determine their number, depending on the forecast scenarios of economic development.

In turn, the number of entrants of the first group can be determined on the basis of the estimated number of graduates of ninth grade, which is calculated using the method of age movement. Thus, the number of students at the beginning of each subsequent school year will be determined by the formula:

$$S_{i+1}^{(t+1)} = k_{i+1} \times S_i^{(t)}$$

(3)

Where $S_i^{(t)}$ – the number of students of the i-th class at the beginning of the t-th school year; k_{i+1} transition coefficient (probability) of students of the i-th class to enter (i + 1) class next year.

Table 3 presents statistical data on the number of students of I - IX grades for 2016/17 [3, P. 60-61] and 2017/18 [4, P. 47-48], based on which the calculation of transition coefficients k_{i+1} was conducted.

Table 3. Number of students of I - IX classes, thousands of people

Year	Number of students, thousands of people								
	I grade	II grade	III grade	IV grade	V grade	VI grade	VII grade	VIII grade	IX grade
2016/17	424,6	431,1	402,3	386,2	369,9	347	352,7	345,2	326,0
2017/18	424,7	422,2	428,9	400,7	385,0	368,3	345,7	351,2	343,3
2018/19	-	422,3	420,0	427,2	399,5	383,3	366,9	344,2	349,3
2019/20	-		420,1	418,4	425,9	397,7	381,9	365,4	342,3
2020/21	-			418,5	417,1	424,0	396,2	380,3	363,3
2021/22	-				417,2	415,3	422,4	394,6	378,2
2022/23	-					415,4	413,7	420,6	392,4
2023/24	-						413,8	412,0	418,3
2024/25	-							412,1	409,7
2025/26	-	-	-	-	-	-	-	-	409,8
k_{i+1}		0,994	0,994	0,996	0,996	0,995	0,996	0,995	0,994

Source: developed by the authors

Then, using the obtained values k_{i+1}, perspective calculations of the number of students of II - IX grades for 2020-2025 academic years are performed. Perspective calculation of the number of first grade students in this study was not carried out, as this is not necessary: even with the available data, using the method of age movement, we have the opportunity to obtain the estimated number of ninth grade graduates till 2025/26 inclusive.

According to statistical observations for 2004-2020, the average percentage of ninth grade graduates who continue their education at schools is 64.87%. That is, 35.12% of graduates leave the school after the ninth grade. Of these, 94.5% enter vocational institutions for full secondary education and qualification "Skilled Worker". Thus, knowing the prospective number of graduates of ninth grade, table 3, we can calculate the corresponding contingent of entrants to vocational institutions, Table 4.

Table 4. Perspective calculations of the number of entrants to vocational institutions, thousands of people

Year	Number of students, IX grade (thousands of people)	Admitted graduates of ninth grade to vocational institutions, long-term calculations (thousands of people)	Admitted applicants who already have a complete secondary education (prospective calculations), thousands of people		
			Baseline scenario	+10%	-10%
2020/21	363,3	120,6	127,5	114,8	140,3
2021/22	378,2	125,5	125,0	112,5	137,5
2022/23	392,4	130,2	132,7	119,4	145,9
2023/24	418,3	138,8	138,1	124,3	151,9
2024/25	409,7	136,0	143,3	128,9	157,6

Source: developed by the authors

As noted earlier, an average of 37.28% of vocational education institute entrants already have a complete secondary education. Therefore, the baseline scenario, table 4 assumes that this trend will continue in the future. In addition, we considered two other possible scenarios of the economic situation, in one of which the demand for technical specialties is growing, and in the other continues to decline. Thus, on the output of table 4 we get the total number of entrants admitted to vocational institutions.

To predict the number of graduates of vocational institutions, based on entrants, we applied formula (3) of the method of age movement again. Considering that the average term of study in vocational institutions is two years, on the basis of statistical data we found the values of transition coefficients, which were: $k_1 = k_2 = 0.93241$. That is, almost 6.8% of students are expelled each year for various reasons, which is much higher than similar figures for schools. Therefore, it is an additional reserve for student growth.

Thus, in Figure 4 are shown the results of forecasting vocational institutions graduates, taking into account the baseline, pessimistic and optimistic scenarios:
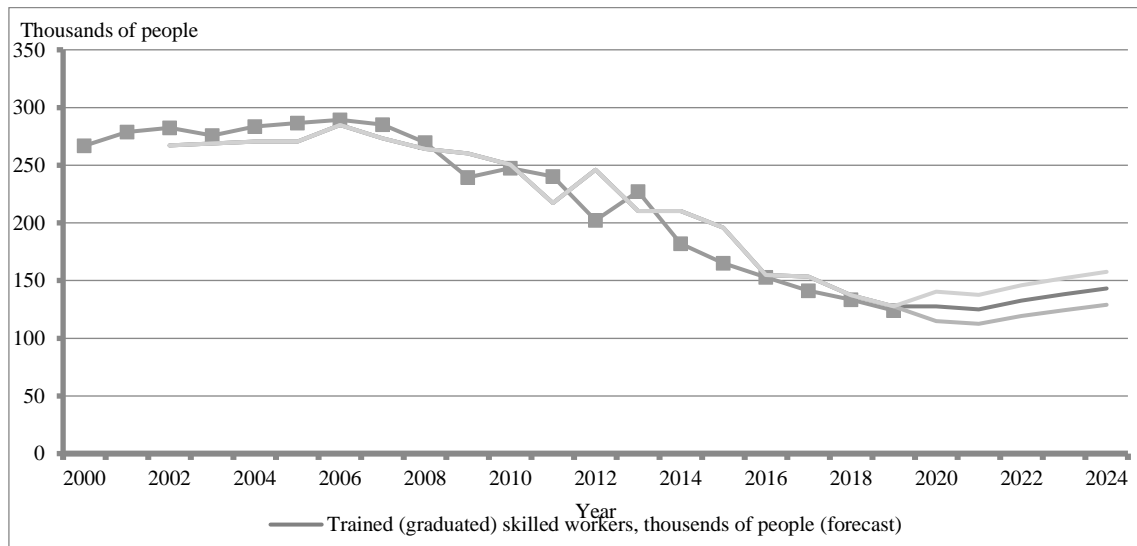

Figure 4 – Shows forecasting of the number of vocational institutions graduates
Source: developed by the authors

The period from 2002 to 2019 contains both statistical and estimated data on the number of graduates. The adequacy of the obtained calculations was checked using Fisher's criterion, for the number of degrees of freedom $m = 2$ and the number of observations $n = 18$. With 95% confidence, it can be stated that the calculated data obtained correspond to the input values, because the calculated value of the Fisher index exceeded the table one ($F_{Фишер} = 46,09 > F_{табл} = 3,81$). Thus, the constructed model can be used for long-term calculations of the number of vocational institutions graduates. This makes it possible to draw the appropriate conclusions:

1.   The obtained forecast dynamics of the target indicator differ significantly from the calculations performed on the basis of linear and polynomial approximation. Despite the long decline, during the next two years it will completely slow down and change to rise, Figure 3. The change in the dynamics of the number of graduates of vocational institutions is due to the graduates of the ninth grade, the number of which is already beginning to grow. Such a conclusion could not be obtained using traditional forecasting methods.

2.   The share of entrants who already have a secondary education and want to study in vocational institutions is so insignificant that their unpredictable change cannot significantly affect the positive dynamics. The contingent of vocational institutions students will still start to grow.

3.   Vocational institutions have unused reserves for the preservation of the contingent, as the share of persons who are annually deducted in the training process exceeds 6%;

4.   Significant reduction in the number of vocational institutions in recent years, Table 1, may lead to a situation where demand exceeds supply. The increase in the number of those wishing to study in vocational schools may exceed the capacity of the education system to build capacity in this direction (Cosmulese, Grosu, Hlaciuc & Zhavoronok, 2019). This will lead to competition between applicants during admission and, ultimately, and improve the quality of education.

IV. DETERMINING THE FACTORS INFLUENCING THE DECISION TO ENTER VOCATIONAL EDUCATION INSTITUTIONS

With the help of the questionnaire, we identified the factors that influence the decision of entrants to enter secondary vocational education. In the Zaporizhia region, students of vocational education institutions were asked to answer the questions of the questionnaire and decide on a 5-point scale assessment of 13 factors selected by us. The main factors influencing entrants when entering vocational education institutions include:

- relatively low requirements for admission (small competition, number of exams, form of exams);
- lack of chances to enter the 10th-11th grades of secondary school, due to poor performance;
- the possibility of receiving professional education at the place of residence;
- the opportunity to receive a scholarship and study for free;
- relatively low cost of education (compared to higher education);
- relatively short terms of training;
- the opportunity to combine study and work;
- continuation of the family dynasty in the profession;
- the possibility of continuing education in the higher education system;
- the opportunity to study with friends;
- at the insistence of parents;
- postponement of conscription into the army;
- others (presence of a dormitory, etc.).

After the questionnaire, the median value was determined to determine the significance of each factor, based on the responses of students. The median is a more stable and correct estimate of the position of the distribution center for a distribution law other than normal, including in the case of measurements on discrete scales, as we have proposed.

Data on the average values of the factors is presented in Table 5.

Table 5. Determination of the factors influencing the choice of applicants in favor of admission to vocational education institutions

No.	Factors	Average value
1	Relatively low requirements for admission (not a big competition, number of exams, form of exams)	5
2	Possibility of employment after graduation	4
3	Opportunity to gain professional education at the place of residence	4
4	Opportunity to get a scholarship and study for free	5

No.	Factors	Average value
5	Relatively low cost of education (compared to higher education)	5
6	Opportunity to study with friends	3
7	Opportunity to combine study and work	4
8	Continuation of the family dynasty in the profession	2
9	Opportunity to continue studying in the higher education system	5
10	Relatively short training periods	4
11	Due to insistence of parents	2
12	Postponement of conscription	1
13	Others (dormitory availability, etc.)	1

Source: developed by the authors

As we can see from the Table 5, the factors influencing the choice of entrants in favor of admission to vocational education institutions can be divided into 4 groups.

The first group is the factors that have the greatest weight, they can be conditionally combined in one direction under the name "factors of accessibility of vocational education", they include:

- relatively low requirements for admission (not a large competition, number of exams, form of exams);

- the opportunity to receive a scholarship and study for free;

- relatively low cost of education (compared to higher education) and the possibility of continuing studying in higher education.

The second group of factors are "professional and labor" factors, that include:

- the possibility of employment after graduation;

- the possibility of receiving professional education at the place of residence;

- the opportunity to combine study and work;

- relatively short training periods.

The third group of factors, which can be called "social and family", include:

- continuation of the family dynasty in the profession;

- parental insistence;

- Opportunity to study with friends.

Finally, the fourth last group of factors, called "others", includes:

- postponement of conscription into the army;

- availability of a dormitory;

- other factors.

V. CONCLUSION

The obtained forecast dynamics of the target indicator differs significantly from the calculations performed on the basis of linear and polynomial approximation. Despite the long decline, within the next two years it will completely slow down and change to rise, fig. 3. The change in the dynamics of the number of graduates of vocational schools is due to the graduates of the ninth grade, the number of which is already beginning to grow. Such a conclusion could not be obtained by using traditional forecasting methods.

The part of entrants who already have a secondary education and want to study in vocational institutions is so insignificant that their unpredictable change cannot significantly affect the positive dynamics. The contingent of students at the vocational institutions will still start to grow.

Vocational education institutions have unused reserves for the preservation of the contingent, as the share of persons who are annually deducted in the training process exceeds 7%;

Significant reduction in the number of vocational institutions in recent years, table. 1, may lead to a situation where demand exceeds supply. The increase in the number of those who wish to study in vocational institutions may exceed the capacity of the education system to build capacity in this direction. This will lead to competition between applicants during admission and, ultimately, to improve the quality of education.

The main factors influencing the decision on admission of entrants to secondary vocational education institutions are: relatively low requirements for admission, the possibility of employment after graduation, the possibility of obtaining vocational education at the place of residence, the ability to combine study and work, the possibility continuing education in the higher education system, etc.

The performed calculations and researches can be further used at formation of directions of the system development of secondary vocational education, thus the basic emphasis should be made on improvement of conditions of training in secondary special educational institutions (the corresponding

financing, rational placement of a network of branches, etc.). It is also necessary to promote the social status of the system of secondary vocational education, strengthen public relations in this direction, work with media, etc.

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