

Business analysis of factors and conditions for the development of sugar production organizations

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Abstract. The purpose of this study is, using the example of sugar production, to identify parametric characteristics and relationships that make it possible to simulate an algorithm and assessment procedures for predicting the possible results of the economic activity of processing organizations in the context of unstable business relations with suppliers of beet raw materials. The developed methodological approach is based on the classification of factors and conditions by sources of occurrence (external, conjugate and internal environment). When modeling scenario and situational changes, the assumptions inherent in the law of "diminishing returns" were made. In particular, only units of the conjugate environment (beet losses during storage and transportation; sugar losses during storage and in production; conjugation coefficient) are presented as dynamic (subject to change) indicators, the rest are positioned as constants, justifiably unchanged in the short term. Approbation of the proposed valuation procedures made it possible to identify imbalances in the level of dynamics of the resulting indicators (specific profit from sales (per ton of product) and profitability of sales with deviations in the values of the conjugation coefficient of the relative base level characterizing the balance of business relations with suppliers. Based on the results obtained, a conclusion was made about the possibility of manifestation of the established disproportions and the effective use of the proposed methodological approach for their leveling in the subjects of other industries.

1 Introduction

The development of economic activity of organizations of sugar production in Russia is undergoing significant changes initiated by the influence of diverse and ambiguously

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influencing factors of the external, associated and internal business environment [1]. Having mainly a socio-economic nature, the named factors are interdependent and interrelated in the closest and most diverse way [2]. The reciprocal influence of factors, first, is expressed in the polarity of influence, and based on the dual effect of synergy forms both positive and negative conditions for conducting economic activity, and, accordingly, the possibility of developing sugar production. The development of the economic activity of sugar factories is associated with the constant search and mobilization of unused opportunities of the available resource potential, as well as the system of business relations. Therefore, it becomes necessary to update the management tools of organizational development, first of all, based on the knowledge of environmental factors [3], which are the reason for the formation of conditions that impede the development of economic activity of processing organizations of sugar production.

When assessing the possibilities of conjugating the interests of participants in business processes in sugar production, it is necessary, first, to identify the key factors, the structure and interrelation of which affects the result - profit per ton of sugar. We have classified the types of factors and conditions that affect the results of the development of the economic activity of sugar factories, and have classified the key environmental factors that prevent favorable conditions for the development of sugar production (Table 1). During the assessment of the identified factors, the special status of the factors of the associated environment was established - the nature and content of business relations with producers of beet raw materials and beet seeds, which determine the qualitative parameters of the business process "harvesting beet raw materials".

Table 1. Key factors and environmental conditions that hinder the development of economic activity of sugar production organizations.

Environment	Factors	Conditions
1	2	3
External	Macroeconomic Processes	The sugar market of the CIS countries is under pressure from imports from third countries
		Introduction of financial and economic sanctions against Russia by a number of foreign countries
		Negative dynamics of national currencies against the dollar and euro, leading to an increase in the cost of sugar in the national currency
		The global sugar balance is in surplus and is under pressure from accumulated excess stocks
	Natural and climatic conditions	Climate change leads to an increase in temperature, precipitation and, as a consequence, the volume of harvesting of sugar beets, sugar supply on the market, changes in prices and incomes of beet and sugar producers
		Climatic conditions unpredictably affect the yield of beets and their quality characteristics, the length of the season, the use of production capacity and production costs
	Market conditions	Population incomes grow at a slower pace than prices for goods and services, which limits consumer demand
		The existence of a surplus of sugar in the world is combined with uneven demand
		Low wholesale prices for beet sugar that persist for a long time with a constant increase in prices for fuels and lubricants, fertilizers, plant protection products, equipment and other resources, reduce the profitability of sugar production
		Decrease in sugar consumption in Russia due to increased competition from manufacturers of sugar substitutes

	Raw materials production	In the context of tougher sanctions, restrictions on the supply of seed material and changes in its price environment may arise, which in the next production cycle will cause an increase in prices on the market for its processed products
		Exceeding the optimal load on one unit of beet-harvesting equipment, insufficient provision of farms with combines and unsatisfactory condition of their material and technical base
		Imperfect organization of field cagation processes
		Low level of application of resource-saving technologies and the use of seed material of regionalized hybrids adapted to stress factors of beet-growing regions of the country
		Early harvest of sugar beets due to lack of processing capacity
		The use of imported seeds that are not adapted to the conditions of reproduction in Russian climatic conditions does not bring the expected results
		Causes of sugar beet losses: suboptimal setting of equipment during harvesting (combines, loaders), non-compliance with technical standards during storage in the field, suboptimal planning of the digging sequence, volumes of transportation to the plant
		Due to the lack of working capital, mineral fertilizers are not applied at the optimal time (August, September) or are used in an incomplete volume
		The lack of clear motivation of farms does not give them the opportunity to conclude insurance contracts, therefore they depend on natural disasters, the dishonesty of sellers and manufacturers of products necessary for growing crops
		When harvesting, errors occur that cannot be corrected - non-compliance with the row spacing, uneven fields
		Insufficient attention is paid to the pre-harvesting maintenance of beet crops, sorting them by quality and shelf life
Conjugate	Business relationships with contractors	The mismatch between the economic interests of beet-growing farms and sugar factories, contributing to the reduction of material and technical and labor resources and undermining food security
		The imbalance in the production and processing of raw beets is explained by the divergence of interests of the participants in sugar production
		Refusal of sugar factories to accept raw materials from third-party beet-growing farms at beet-receiving points; the requirement to store beets in field piles, then supply them to the plant according to an insufficiently agreed schedule
Procurement of raw materials		The lack of beet-receiving points equipped with modern high-performance handling equipment, low keeping quality of sugar beet reduces the weight and quality of root crops, which leads to an increase in the loss of beet raw materials
		The direction of development of beet processing "off wheels", which was wrongly chosen by Russian producers
Internal	Technical base	Reduction of production capacity due to the withdrawal of capacity for reconstruction, violation of the optimal structure of crops, leading to an unreasonable increase in the cost of transporting raw materials
		Lack of production capacity complicating the production process and increasing the cost of sugar production
		Raw materials laboratories do not have the ability to quickly check the correctness of the results obtained on automated lines, so they are assigned to the central plant laboratories, where discrepancies arise in the results of determining the sugar content
	Raw material storage and processing	
In raw materials laboratories, physically and morally obsolete equipment is used		

	Energy base	Energy technology complexes are characterized by high cost and sophisticated equipment, slowly adapting to the new realities of pricing
		The used energy equipment of foreign production is outdated, lags behind the modern world level of development
	Human resources	Sugar production is one of the most traumatic types of food production; almost all blue-collar occupations are classified as hazardous occupations
		The existing system of labor relations does not stimulate the employer to improve the working conditions of the personnel, since the measures for their implementation require significant financial costs in accordance with state regulations
	Management	Insufficient use of information systems due to the lack of a mathematical description of objects and basic processes
		Methods and tools of functional management are used in the management of sugar production; the benefits of process management focused on business processes are practically not realized

The factors considered directly or indirectly determine the possibilities for the development of processing companies in the current crisis-market space, which is accompanied by an increase in the influence of destabilizing factors and necessitates an appropriate response. The methods and management tools used in sugar production organizations in most cases demonstrate an imbalance of business interests, underestimation of the possibilities for the expedient development of economic factors that contribute to the protection of competitive advantages and the harmonization of business relations [4]. As a result, it is expedient to switch to systemic management of economic factors of economic activity of processing organizations, using adequate management tools to neutralize or weaken the influence of factors that inhibit or impede the development process.

2 Materials and methods

It is advisable to assess the impact of natural, production and economic indicators that quantitatively and qualitatively characterize the causes; it is advisable to carry out based on a structural-logical block diagram, which makes it possible to establish the presence and direction of connections not only between the factors themselves, but also between them and the effective indicator. In fig. 1 shows the key factors that generate (mainly) production risks, as well as their impact on the specific profit (tons of sugar). Thus, the systematization of economic factors allows for a deeper study of their interrelationships and direction of impact in the formation of the value of the effective indicator, which is of no small importance at the next stages of assessing the possibilities of conjugation of interests of participants in sugar production, especially at the stage of modelling the vector of dynamics of the studied indicators [5].

At the theoretical level, the production potential can be formalized as follows:

$$P = (k, f, R), \tag{1}$$

where P – production potential of organization; R – resources of organization; f – resource organization level; k – level of realization of untapped opportunities.

The key factor in the conjugation of business interests is the reason that directly or indirectly forms the level of organization of resources and untapped opportunities of resource potential:

$$f = \left(K_f, \begin{matrix} k \\ P_{tech} \\ P_m \\ P_{lab} \end{matrix} \right), \tag{2}$$

where K_f – the key factor in the conjugation of business interests; P_{tech} – technical component; P_m – material component; P_{lab} – labour component.

For sugar factories that use sugar beets for processing, the most significant and influential are situations, phenomena, events related not so much to the external and internal, but to the conjugate environment in which the business interests of the parties are coupled and under the influence of the factors of which there is an increase and accelerating the bi-directional synergy effect. It is possible to assess the sources and causes of the available opportunities in the business environment in terms of the characteristics of the influence of individual factors on the level of economic activity. As factors that are particularly important for sugar production, the factors that arise and act mainly in a conjugate environment are identified and substantiated – these are the losses of beet raw materials during storage, transportation, and sugar during storage and processing. To assess the influence of the conjugate environment on the economic activity of sugar factories processing sugar beets, it is proposed to use the calculated coefficient of conjugation of business processes (coefficient of the conjugate environment influence), taking into account the total losses of sugar with beets during storage and transportation and sugar in production [6]:

$$K_c = \left(1 - \frac{L_s}{100}\right) \cdot \left(1 - \frac{L_{s\ sug}}{100}\right) \cdot \left(1 - \frac{L_{pr}}{100}\right), \tag{3}$$

where L_s – losses of beets during storage and transportation, as a percentage of harvested beets; $L_{s\ sug}$ – loss of sugar during storage, as a percentage of harvested beets; L_{pr} – sugar losses in production, including sugar content in molasses, as a percentage of harvested beets.

In other words, from an economic point of view, the value of the conjugation coefficient (K_c), always less than 1 is interpreted as follows: $K_c \rightarrow 1$, but $K_c \neq 1$. The closer K_c is to one, the less the influence of the associated environment, and the more opportunities for the organization of the sugar industry to increase profitability and develop economic activity.

When assessing the level of conjugation of interests, it is also necessary to take into account the specifics of this or that business process (groups of business processes). In particular, we will consider the influence of such factors as losses of beets and sugar during storage and transportation on the specific profit (per ton of sugar) and sales profitability, taking into account the following assumptions:

- natural and climatic conditions in a particular region differ from those in other regions, that is, a poor harvest of beets and their sugar content in a particular region does not have a significant effect on the market price of selling sugar beets, that is, on the amount of material costs of a sugar refinery;
- sugar factories cannot have a significant impact on the loss of beets during storage and transportation by means of additional costs in extreme conditions: for example, high temperatures, excessive precipitation during harvesting.

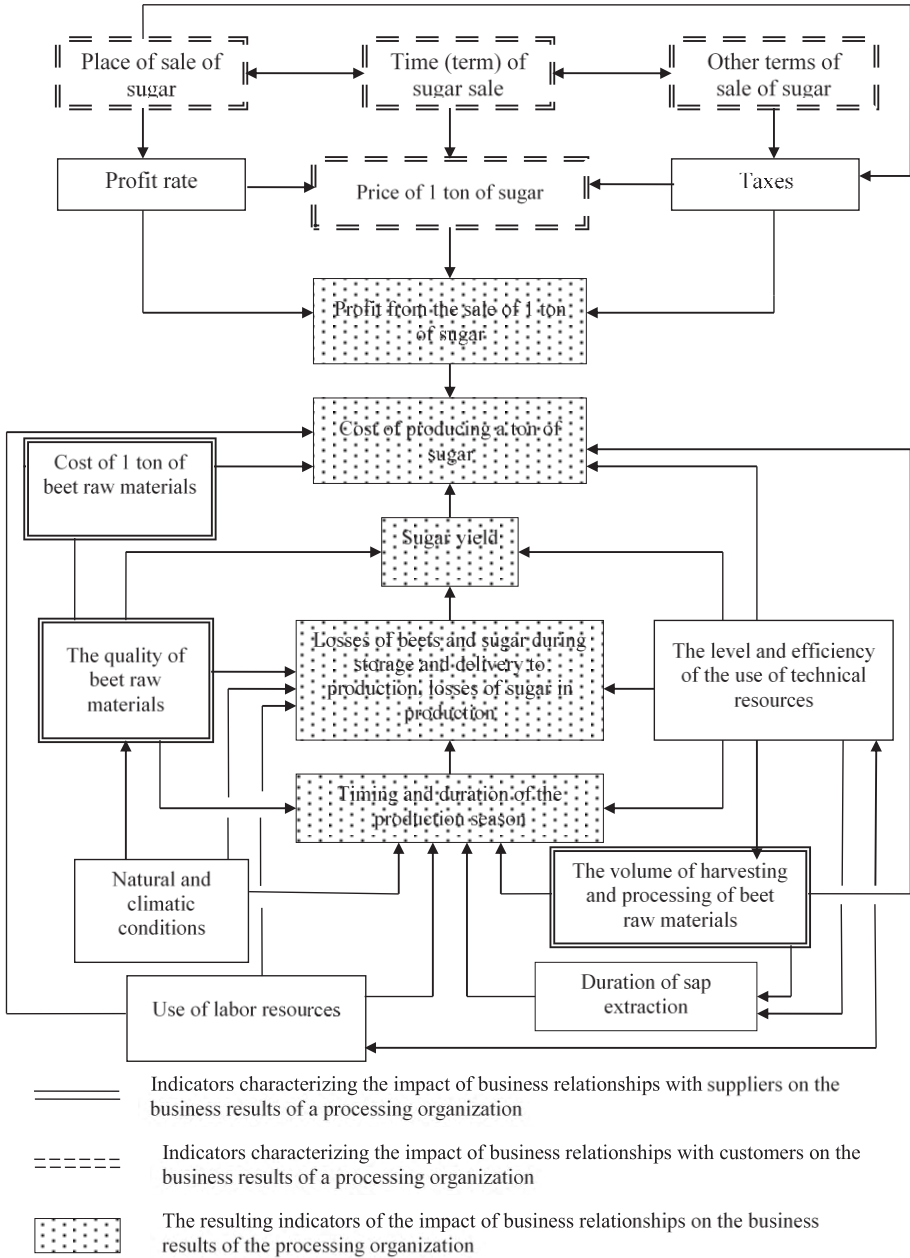


Fig. 1. Influence of key factors in the development of business relations on the results of economic activity of sugar processing organizations.

In this regard, a certain value for predicting and preventing (or reducing) risks is the development of a model for finding functional dependences of the specific profit (per ton of sugar) on the level of dynamics of conjugation of business interests of the participants in sugar production. Here is an algorithm for modeling this process [7].

$$P = Pr - C_{pr}, \tag{4}$$

where P – profit per ton, rub., Pr – selling price of 1 ton of sugar beet, rubles / ton, C_{pr} – cost price of 1 t, rubles / t.

After purchasing the harvested sugar beet material costs (costs for beet raw materials) $MC = \text{const}$ and do not depend on the amount of beets that will be processed. Therefore

$$C_{pr} = C_{var.sp.} + \frac{C_f + C_{beet}}{A_p}, \tag{5}$$

where C_{pr} – production cost, p.; C_f - fixed costs, p.; C_{beet} – the cost of harvested beet raw materials; $C_{var.sp.}$ – specific variable costs (minus the cost of beet raw materials), rubles / t; A_p – the amount of sugar produced, t.

$$A_p = A_h \cdot (1 - L_{st}) \cdot Yld \tag{6}$$

where A_h – the amount of harvested sugar beet, t; L_{st} – losses of beets during storage and transportation, units; Yld – sugar yield, units

Thus, we get:

$$P = Pr - C_{var.sp.} - \frac{C_f + C_{beet}}{A_h \cdot (1 - L_{st}) \cdot Yld}. \tag{7}$$

After the completion of the process of harvesting beet raw material, the sugar content of the beet on acceptance can be conditionally considered unchanged, in turn, the results of production activities begin to be influenced by factors of the conjugate environment, including sugar loss.

Potential change in profit:

$$\Delta P = \frac{C_f + C_{beet}}{A_h \times Sug} \times \frac{\Delta C_C + C_{C1} - C_{C1_0}}{C_{C1} \times (\Delta C_C + C_{C1})}; \tag{8}$$

$$\Delta P = \frac{C_f + C_{beet}}{A_h \times Sug} \times \frac{\Delta C_C}{C_{C1} \times (\Delta C_C + C_{C1})}. \tag{9}$$

If the planning goal is to determine the impact of both the external (in terms of interaction with suppliers) and the associated business environment on changes in income and profitability, then the sugar content and the cost of beet raw materials should be used as variables, taking into account its sugar content [8].

3 Results and discussion

For the correct performance of the reference comparison based on the values of the coupling coefficient, the following assumptions were used, which are acceptable for the modern development of sugar production technology in Russia on the example of a sugar plant with a production capacity of sugar beet processing 3000 t / day [9,10,11]:

- loss of sugar beet during storage and delivery to production – 4.6 %;
- loss of sugar during storage – 0.5 %;

- sugar losses in production, including sugar content in molasses – 2.72 %.
 The calculated baseline level of the conjugation coefficient was 0.923 units. Thus, for the case under consideration, the level of profit dynamics per ton of sugar produced is described by the following functional relationship:

$$\Delta P = (70593 + 882414) / (294138 * 17.01 / 100) * C_c / (0.923(C_c + 0.923));$$

$$\Delta P = 20.6366 * \Delta C_c / (\Delta C_c + 0.923).$$

Perceiving business relations as one of the main factors of economic activity, we made an assumption about the possible operation of the "law of diminishing returns" in the context of the categories under consideration, which manifests itself in the different-sized dynamics of the resulting indicator (profitability of sales) with an increase / decrease conjugation coefficient and unchanged values of other indicators [12,13]:

- the volume of harvested beets – 294138 tons,
- sugar content of sugar beet on acceptance – 17.01%;
- purchase price of sugar beet - 3000 rub./ton (excluding VAT);
- the amount of fixed costs – 70593 thousand rubles;
- the sum of other variable costs (except for raw materials costs) – 223545 thousand rubles;
- total costs (raw material costs + fixed costs + other variable costs) – 1176552 thousand rubles;
- sugar sales price – 35000 rub./ton (excluding VAT)

For the purpose of the study, a step was adopted for changing the values of the coupling co-efficient ± 0.5% (in the range of 0.873-0.979 units), which has a direct effect on the volume of sugar production and sales (tables 2-4). In this case, it is not of fundamental importance that of the indicators and to what extent had a positive / negative effect on the change in the conjugation coefficient [14, 15].

Table 2. Influence of the level of business relationships with suppliers on profit and sales profitability.

Coupling coefficient, units	The amount of sugar produced, t.	Proceeds from the sale of sugar, thousand rubles	Total costs, thousand rubles	Profit from the sale of sugar, thousand rubles	Sales profitability, %
0.979	48973	1714054	1176552	537502	31.36
0.974	48742	1705968	1176552	529416	31.03
0.970	48511	1697883	1176552	521331	30.70
0.965	48280	1689798	1176552	513246	30.37
0.960	48049	1681713	1176552	505161	30.04
0.956	47818	1673628	1176552	497076	29.70
0.951	47587	1665543	1176552	488991	29.36
0.946	47356	1657457	1176552	480905	29.01
0.942	47125	1649372	1176552	472820	28.67
0.937	46894	1641287	1176552	464735	28.32
0.933	46663	1633202	1176552	456650	27.96
0.928	46432	1625117	1176552	448565	27.60
0.923	46201	1617032	1176552	440480	27.24
0.919	45970	1608946	1176552	432394	26.87
0.914	45739	1600861	1176552	424309	26.51
0.910	45508	1592776	1176552	416224	26.13
0.905	45277	1584691	1176552	408139	25.76

0.900	45046	1576606	1176552	400054	25.37
0.896	44815	1568521	1176552	391969	24.99
0.891	44584	1560436	1176552	383884	24.60
0.886	44353	1552350	1176552	375798	24.21
0.882	44122	1544265	1176552	367713	23.81
0.877	43891	1536180	1176552	359628	23.41
0.873	43660	1528095	1176552	351543	23.01
0.868	43429	1520010	1176552	343458	22.60

Table 3. Influence of the level of business relations with suppliers on specific indicators of economic activity.

Coupling coefficient, units	Material costs (beet raw materials) per ton of sugar, r.	Fixed costs per ton of sugar, r.	Total costs per ton of sugar, r.	Profit per ton of sugar, r.
0.979	18018	1441	24025	15540
0.974	18104	1448	24138	15448
0.970	18190	1455	24253	15355
0.965	18277	1462	24369	15261
0.960	18365	1469	24487	15166
0.956	18454	1476	24605	15070
0.951	18543	1483	24724	14973
0.946	18634	1491	24845	14876
0.942	18725	1498	24967	14777
0.937	18817	1505	25090	14677
0.933	18910	1513	25214	14577
0.928	19004	1520	25339	14475
0.923	19099	1528	25466	14373
0.919	19195	1536	25594	14269
0.914	19292	1543	25723	14164
0.910	19390	1551	25854	14058
0.905	19489	1559	25986	13952
0.900	19589	1567	26119	13844
0.896	19690	1575	26254	13735
0.891	19792	1583	26390	13624
0.886	19895	1592	26527	13513
0.882	19999	1600	26666	13401
0.877	20105	1608	26806	13287
0.873	20211	1617	26948	13172
0.868	20319	1625	27091	13056

Table 4. Assessment of deviations of indicator values from the baseline.

Coupling coefficient, units	Deviation of the conjugation coefficient, units	Increase in the coefficient of conjugation, %	Profit deviation, thousand rubles	Deviation in profits per ton of sugar, rub/t	Deviation of sales profitability, pn.
0.979	0.055	6.00	97022	1168	4.12
0.974	0.051	5.50	88937	1075	3.79
0.970	0.046	5.00	80852	982	3.46
0.965	0.042	4.50	72766	888	3.13
0.960	0.037	4.00	64681	793	2.80
0.956	0.032	3.50	56596	698	2.46
0.951	0.028	3.00	48511	601	2.12

0.946	0.023	2.50	40426	503	1.77
0.942	0.018	2.00	32341	404	1.43
0.937	0.04	1.50	24255	305	1.08
0.933	0.009	1.00	16170	204	0.72
0.928	0.005	0.50	8085	103	0.36
0.923	0	0	0	0	0.00
0.919	-0.005	-0.50	-8085	-104	-0.37
0.914	-0.009	-1.00	-16170	-208	-0.73
0.910	-0.014	-1.50	-24255	-314	-1.11
0.905	-0.018	-2.00	-32341	-421	-1.48
0.900	-0.023	-2.50	-40426	-529	-1.87
0.896	-0.028	-3.00	-48511	-638	-2.25
0.891	-0.032	-3.50	-56596	-748	-2.64
0.886	-0.037	-4.00	-64681	-859	-3.03
0.882	-0.042	-4.50	-72766	-972	-3.43
0.877	-0.046	-5.00	-80852	-1086	-3.83
0.873	-0.051	-5.50	-88937	-1201	-4.23
0.868	-0.055	-6.00	-97022	-1317	-4.64

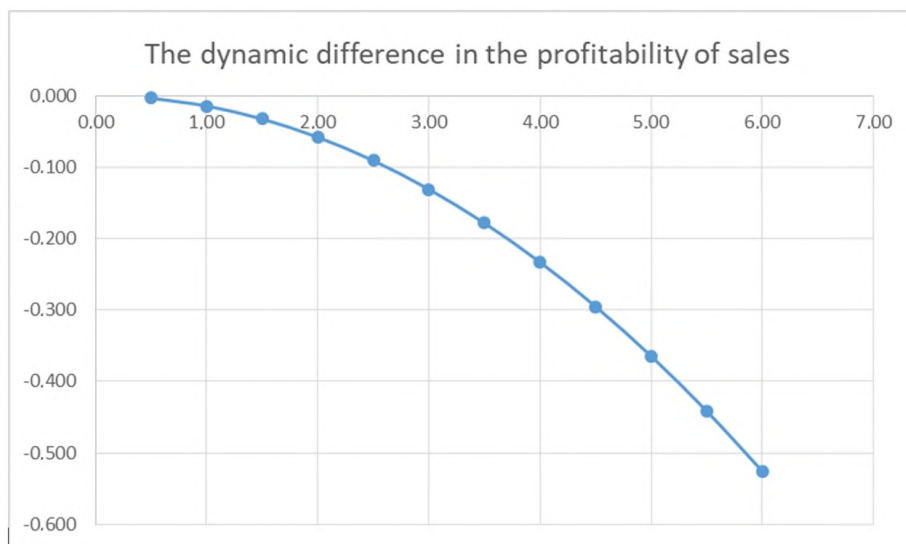


Fig. 2. The dynamic difference in the profitability of sales with equal, but oppositely directed deviations of the values of the coupling coefficient from the base level.

Let us evaluate the results of the situations we have modeled, depending on the change in the coupling coefficient, which takes into account the total losses of beets and sugar during storage, delivery to production and in production [16-17]. Reducing losses to a level, for example, sugar losses during storage - 0.42%, sugar losses in production, incl. content in molasses - 0.85%, losses of beets during storage and delivery to production - 1.18% led to an increase in the coupling coefficient by 0.055 units (an increase of 6%), which in turn affected the specific profit, increasing it by 1168 rubles / t (an increase of 8.12%) (table 5) [18]. Against this background, the increase in profitability amounted to 4.12 pn, which ensured an increase in the mass of profit by 97.022 million rubles [19]. An increase in losses, and as a consequence, a decrease in the level of the conjugation coefficient by the same percentage points, led to the same reduction in the mass of profit by 97.022 million rubles (decrease -9.16%) and a decrease in profitability by 4.64 pn. Thus, we can conclude that the deviation of the coupling coefficient from the baseline in the range [-6%; +6%] has

a different-sized impact on the profitability of business activities in two areas of dynamics - [-4.64 pn; 4.12pn. [20] . The clearly identified dynamic differences demonstrating the prevailing influence of the negative vector of deviations are shown in Figure 2.

4 Conclusion

Due to the constantly changing conditions for the functioning of organizations under the influence of a dynamic business environment, as well as the laboriousness of drawing up flexible budgets with a lot of indicators that are not used for evaluation and analysis, many authors express an opinion about refusing to draw up flexible budgets in favor of assessing key impact indicators, which characterizes the proposed approach as relevant for the purpose of predicting the level of profitability and assessing business activities.

The obtained ratios allow us to state the presence of certain dynamic imbalances in the change in the level of profitability, the manifestation of which increases with the growth of the range of deviations of the conjugation coefficient from the base level. The perception of the base level of the values of the assessed indicators and indicators forms a certain parametric model that fragmentarily characterizes the system of harmonious business relations between producers and processors of beet raw materials. With an equal change in the coefficient of the conjugate environment, a higher rate of decrease in the specific weight of profit (per ton of sugar) is observed in comparison with an increase in this indicator, therefore, the management of related factors affecting the specific profit (losses of beets and sugar during storage, transportation and in production), is of key importance in the process of generating in-comes of processing organizations of sugar production and characterizes the need to reduce these losses in order to optimize the profitability of economic activity.

In the course of the evaluation and analytical procedures, it was found that the resulting indicator (profit) and indicator (profitability) are not significantly influenced by the composition and structure of costs, which confirms the conditional isolation of the factors of the associated environment and their specific impact on the results of economic detail processing organizations of sugar production. In addition, this feature, as well as the almost single-product nomenclature of sugar production, makes it possible to conclude that the revealed proportions (disparities) are comparable for organizations with a greater or lesser production capacity, as a rule, with a significantly different mass of fixed costs. At the same time, if one of the objects of appraisal procedures is marginal income or break-even production volume, then the composition and structure of production costs will be essential for obtaining correct analytical results and conclusions.

The revealed dependence of the resulting indicators is characteristic not only for sugar production, but also for other sectors of the agro-industrial complex, including agriculture, and should be taken into account by managers when planning production activities and budgeting.

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