The Journal of Social Sciences Research
ISSN(e): 2411-9458, ISSN(p): 2413-6670
Special Issue. 5, pp: 175-180, 2018
URL: https://arpgweb.com/journal/journal/7/special_issue
DOI: https://doi.org/10.32861/jssr.spi5.175.180

Academic Research Publishing Group

Original Research

Open Access

Managing the Production Program of a Small Innovative Chemical Enterprise in the Face of Changing Demand

I. L. Beilin*
Kazan Federal University, Institute of Management, Economics and Finance

V. V. Khomenko
Kazan Federal University, Institute of Management, Economics and Finance

N. M. Yakupova
Kazan Federal University, Institute of Management, Economics and Finance

E. I. Kadochnikova
Kazan Federal University, Institute of Management, Economics and Finance

D. D. Aleeva
Kazan Federal University, Institute of Management, Economics and Finance

Abstract

The article examines the economic problems of innovative enterprises, taking into account the cyclical nature of their development, which are characterized by models of increasing profits with the least losses. As the main method, additive convolution is used with equally important and weighted demand for an innovative product. The estimation of the economically optimal volume of products is presented. The research is complex and can have an impact on social, environmental and other performance indicators of the production sector of the economy. The process of globalization has led to the emergence of a complex network of relationships in the business environment. In a free market economy, this means an increased complexity and uncertainty of factors affecting the financial position of the entities. At present, many features of the finance and economics of innovative enterprises are unclear, which makes it difficult to analyze using traditional methods of economic and mathematical modeling. Forecasting the bankruptcy of business and consumers is also inaccurate and ambiguous, as many internal and external factors influence this process. Even a simple statement that an enterprise or a consumer is at risk of bankruptcy should be considered inaccurate and in fact, rarely in an economic reality there are entities that can be considered bankrupt 100%. It is almost impossible to accurately determine the degree of threat of bankruptcy using traditional statistical methods, such as multidimensional discriminant analysis. When the value of the discriminant function is less than the threshold value, it is considered that the enterprise is exposed to the risk of bankruptcy. Given the cyclical nature of the development of an innovative enterprise, it seems necessary to define ambiguous concepts, such as "high risk of bankruptcy" or "low risk of bankruptcy." We need approaches that can be used not only to predict the level of risk, but also to determine the degree of positive financial position of the analyzed enterprise, for example, "High Solvency" or "Average Solvency", depending on changes in the production program.

Keywords: A production program; A changing demand; An innovative enterprise.

1. Introduction

Foreign economic instability increases the number of innovative enterprises that are under threat of bankruptcy around the world. In addition, extreme globalization has resulted in the economies of entire countries also being affected by it (for example, countries such as Greece or Iceland are at risk of bankruptcy, the US credit rating is downgraded from AAA to AA + rating agencies for the first time in history) that directly or indirectly affects the financial situation of the production sector. Therefore, analysts are currently faced not with the dilemma of the need to forecast the financial and economic situation of innovative enterprises, but what forecasting method is used to minimize forecast errors in conditions of cyclical development. In practice, this is especially true:

In the context of early warning of the deterioration of the financial and economic state of the innovative enterprise,

In terms of assessing the solvency of partners and customers,

From the point of view of credit risk assessment by financial institutions,

In the context of the implementation of financial and economic plans in the company,

From the point of view of risk assessment, the purchase of shares by individual and institutional investors on stock exchanges,

In the context of credit assessment of consumer credit applications by banks,

*Corresponding Author

From the point of view of threat of bankruptcy of consumers, in the literature, the models of forecasting the economic efficiency of an innovative enterprise under conditions of cyclic development are divided into three main groups (Alidi, 1996; Korol, 2011).

These are statistical models, theoretical models and models using soft computing methods that are part of a single field of science, defined as computational intelligence (the term is understood as solving various problems with the help of artificial intelligence). According to the literature, 64% of the cases used statistical models, 25% soft calculation methods and 11% of other types of models.

In the statistical models, the individual financial ratios of the innovative enterprise are estimated. The choice of each relationship is based on empirical studies of groups consisting of producers and consumers with good financial standing and risks. In addition, the set of indicators is reduced by excluding variables of similar information, for example, which correlate with each other. After determining the set of diagnostic variables, the model parameters are evaluated. Each chosen variable takes a discriminatory weight (Alfares H. and Al-Amer, 2002; Alfares H. K., 2007).

The model of forecasting the bankruptcy of an innovative enterprise in conditions of cyclical development is created by gradual "compaction" of a set of individual relations in order to obtain a single index, called a synthetic indicator. "Sealing" is carried out using the appropriate statistical and econometric methods. The use of such a model to assess the optimal performance of an enterprise is a replacement of the actual value of financial ratios and the calculation of a synthetic risk indicator. This synthetic index characterizes the financial position of the company being audited (Al-Qahtani et al., 2008).

2. Methods

The method of collapsing the criteria involves transforming the set of available particular criteria into one super criterion. The main stages of coagulation are:

1. The justification of the admissibility of convolution. When justifying the admissibility of a convolution, we must first of all confirm that the criteria that we "fold" must be homogeneous. There are such groups of performance indicators: performance indicators; indicators of resource intensity; indicators of efficiency. The criteria that we are curtailing must apply to the same group. It is not possible to curtail criteria, which include, for example, one of them to the indicators of efficiency, and the other to performance indicators. For each group, the curtailment of particular criteria should be carried out separately. If this principle is violated, the sense of the criterion is lost (Beilin and Arkhireev, 2011).

2. Consideration of criteria priorities. Priority accounting is usually given to some weight vectors that reflect the importance of a criterion for the task at hand (Kumar and Ravi, 2007).

3. Construction of the convolution function. To reduce the criteria, use such basic types of functions: additive convolution functions; multiplicative; aggregated, and there may be other variants of the packages.

3. Results and Discussions

The use of statistical models requires that the variables used in the model meet the following assumptions: indicators should have normal distributions, indicators should be independent, indicators should have a high discriminatory ability to separate solvency factors from insolvency factors, the classification of objects should be clearly defined - belonging to one group excludes its belonging to the second group (Mcleay and Omar, 2000).

Unlike statistical models, soft computing methods effectively cope with inaccurately defined problems, incomplete data, inaccuracies and uncertainty arising in the economy of an innovative enterprise, taking into account the cyclical nature of its development. The forecast of optimal performance of an innovative enterprise has all of the above assumptions. In addition, soft computing models are suitable for use in dynamic systems for which internal parameters vary depending on external economic factors (Beilin and Khomenko, 2018; Nwogugu, 2007).

statistical between statistical models and models of soft computing lies in such aspects as reliability and accuracy of the variables used. Soft computing technologies, in contrast to statistical models, thus allow inaccurate data, uncertainties and approximations. The essence of models based on computational intelligence is the processing and interpretation of data with varying degrees of reliability.Literary studies show that models of discriminant analysis predominate in forecasts of the financial and economic state of an innovative enterprise, which account for 30.3% of all methods - statistical, soft calculations and theoretical ones. Undoubtedly, the most popular model for forecasting the risk of bankruptcy is the model developed by the American professor E. Altman. As a pioneer in the use of multidimensional discriminant analysis to predict bankruptcy of companies, he developed a model consisting of a single function with five financial coefficients:

$$Z = 1.2 * X1 + 1.4 * X2 + 3.3 * X3 + 0.6 * X4 + 0.999 * X5$$

Where:

X1 = working capital / total assets,

X2 = retained earnings / total assets,

X3 = profit before taxes / total assets,

X4 = market value of shares / general long-term and short-term liabilities,

X5 = sales / total assets.

Altman proposed using three decision areas depending on the value of the Z indicator: if $Z <1.81$, then this is a signal of high probability of bankruptcy, if $1.81 <Z <2.99$, then the risk of a financial malfunction of the company is impossible(this is the so-called"grayarea"),if Z> 2.99, then there is a low probability of bankruptcy (Tahavieva and Nigmatullina, 2017).

We will calculate the best production volumes from the economic point of view using the example of the innovative enterprise "Copolymer +". Demand is considered for equally important and weighted alternatives, when, depending on the rank of the alternative (j), it is given a certain weight (w):

$$w = \frac{2(m - j + 1)}{m(m + 1)}$$

Further, we find for both equally important and for weighted demand revenue and losses, provided that the lost profit in cyclical development of the enterprise also refers to losses (Table 1). As a result, we make a graphic comparison (Fig. 1, Fig. 2).

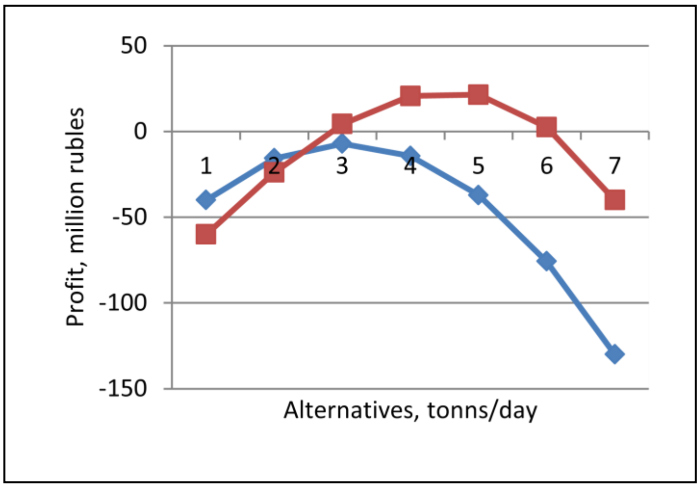
Table-1. Profit and loss for equally important and weighted alternatives of the innovative enterprise "Copolymer +".

PROFIT		**DEMAND**							**Average revenue for equally important alternatives, million rubles**	**Average revenue for weighted alternatives, million rubles**
j		**1**	**2**	**3**	**4**	**5**	**6**	**7**		
SENTENCE	w	0,04	0,07	0,11	0,14	0,18	0,21	0,25		
	1	20	20	20	20	20	20	20	20	20
	2	-15	40	40	40	40	40	40	32,14	38,03
	3	-50	5	60	60	60	60	60	36,42	52,14
	4	-85	-30	25	80	80	80	80	32,85	60,35
	5	-120	-65	-10	45	100	100	100	21,42	60,71
	6	-155	-100	-45	10	65	120	120	2,14	51,25
	7	-190	-135	-80	-25	30	85	140	-25	30
LOSSES		DEMAND							Average losses for equally important alternatives, million rubles	Average losses for weighted alternatives, million rubles
SENTENCE	1	0	20	40	60	80	100	120	60	80
	2	35	0	20	40	60	80	100	47,85	61,96
	3	70	35	0	20	40	60	80	43,57	47,85
	4	105	70	35	0	20	40	60	47,14	39,64
	5	140	105	70	35	0	20	40	58,57	39,28
	6	175	140	105	70	35	0	20	77,85	48,75
	7	210	175	140	105	70	35	0	105	70

PROFIT, MILLION RUBLES	
EQUALLY IMPORTANT ALTERNATIVES	WEIGHTED ALTERNATIVES
-40	-60
-15,71428571	-23,92857143
-7,142857143	4,285714286
-14,28571429	20,71428571
-37,14285714	21,42857143
-75,71428571	2,5
-130	-40

Source: compiled by the authors.

Figure-1. Profit of the innovative enterprise "Copolymer +" with equally important and weighted alternatives, million rubles.

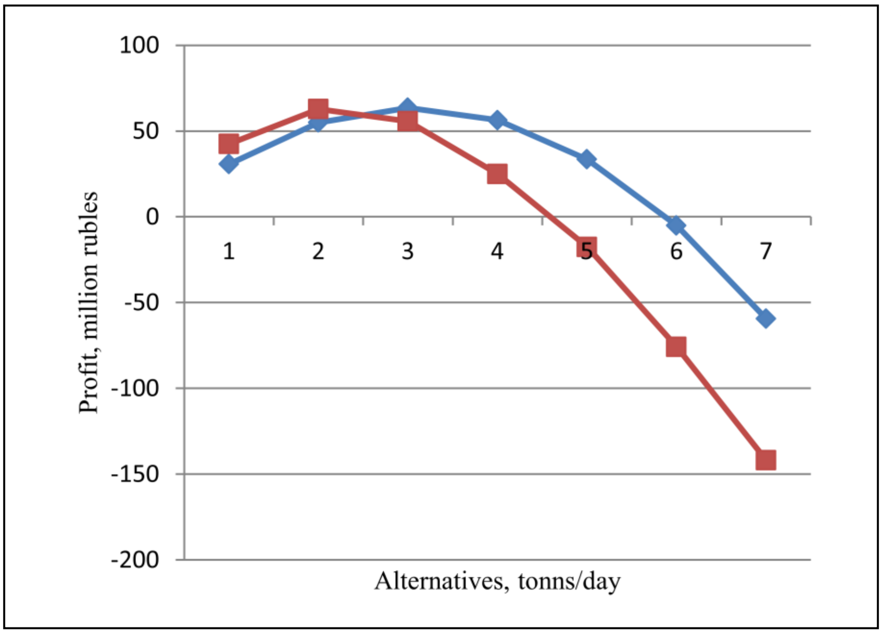


Source: compiled by the authors (Balcaen and Ooghe, 2006).

As a result of the computational work done, it is clear that with equally important alternatives to the demand for an innovative product, no production volumes lead to profit. At the same time, when assessing weighted alternatives, we see that 3-6 tons of innovative product per day are profitable, and the most profitable ones are 4-5 tons per day. Thus, taking into account weight criteria of alternatives to demand makes it possible to significantly adjust the profitability of an innovative enterprise in terms of the cyclical nature of its development and give preference to the most promising projects (Ji, 2004).

The profitability of the innovative enterprise "Copolymer +" increases significantly and becomes comparable for equally important and weighted alternatives, provided that the demand for average volumes of the innovative product is most probable (Figure 2).

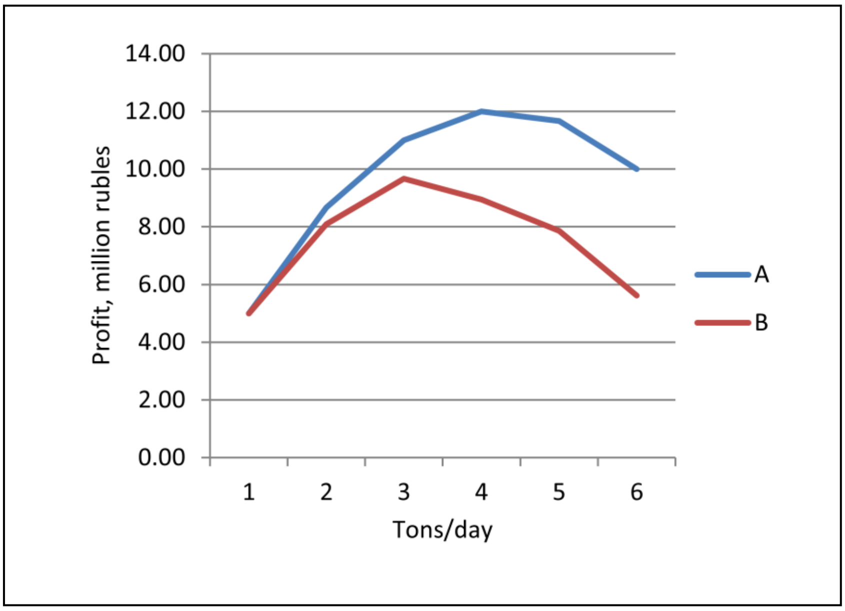
Figure-2. The profit of the innovative enterprise "Copolymer +" with equally important and weighted alternatives, provided that the demand for average volumes of the innovative product is most likely, million rubles.



Source: compiled by the authors.

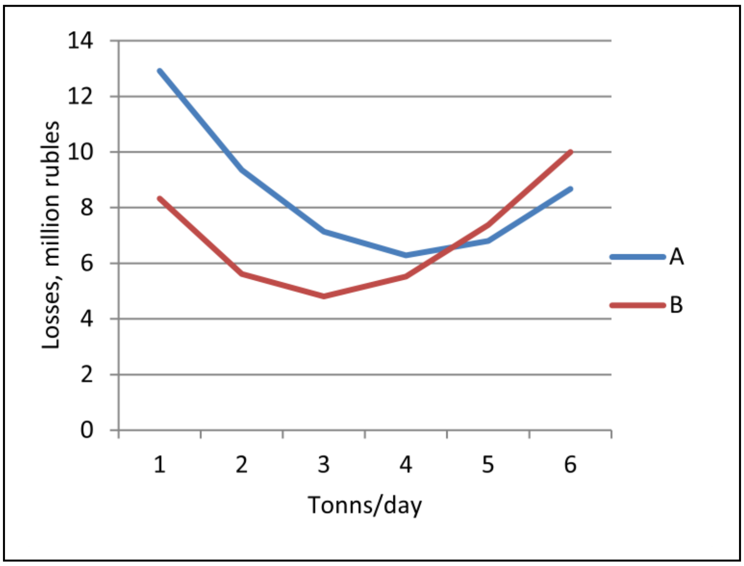
The model developed on the basis of additive convolution makes it possible to compare the optimal volumes of production of an innovative enterprise with greater profits and fewer losses. Using the example of the IIP "Polycarbonate Analogues" it is shown that for equally important and weighted demand, large profits and smaller losses are in the productivity area of 3 and 4 tons of innovative product per day, respectively (Fig. 3, Fig. 4).

Figure-3. Dependence of the profit of a small innovative enterprise "Analog polycarbonate" on production volumes for equally important (A) and weighted (B) demand



Source: compiled by the authors.

Figure-4. Dependence of losses of a small innovative enterprise "Polycarbonate Analogues" on production volumes for equally important (A) and weighted (B) demand



Source: compiled by the authors (Thomas, 2000).

4. Summary

Theoretical models are mainly focused on the use of qualitative information. In contrast to statistical and soft calculations, theoretical models are focused on finding the reasons for the deterioration of the financial and economic state of an innovative enterprise, taking into account the probability of losses. The company continues to function until its net worth reaches zero (bankruptcy). Another example of a theoretical model is the CMS model (Credit Manager Model), based on the use of pricing theory to assess the optimal performance of an innovative enterprise. The use of CMS in a cyclical development environment simulates the probability of a company's value falling below the cost of its obligations (creating a solid insolvency).

5. Conclusions

The developed method of economic evaluation of the optimal productivity of an innovative enterprise is a useful and effective tool for financial analysis. It can be used by specialists in the composition, both basic and auxiliary means of the feasibility study of the innovation project. In the conditions of cyclical development of the enterprise, ranking all criteria of fluctuating demand leads to an increase in the management efficiency of the innovative projects being implemented.

Acknowledgements

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

References

Al-Qahtani, K., Elkamel, A. and Ponnambalam, K. (2008). Robust optimization for petrochemical network design under uncertainty. *Industrial & Engineering Chemistry Research*, 47(11): 3912-19.

Alfares, H. and Al-Amer, A. (2002). An optimization model for guiding the petrochemical industry development in Saudi Arabia. *Engineering Optimization*, 34(6): 671-87.

Alfares, H. K. (2007). A mathematical model for optimum petrochemical multi-grade selection, production, and sequencing. *Analysis of Manufacturing Systems*.

Alidi, A. S. (1996). A multiobjective optimization model for the waste management of the petrochemical industry. *Applied Mathematical Modelling*, 20(12): 925-33.

Balcaen, S. and Ooghe, H. (2006). 35 years of studies on business failure: an overview of the classic statistical methodologies and their related problems. *The British Accounting Review*, 38(1): 63-93.

Beilin, I. L. and Arkhireev, V. P. (2011). The supermolecular structure of new copolymer products based on cyclic carbonates. *International Polymer Science and Technology*, 38(1): T37.

Beilin, I. L. and Khomenko, V. V. (2018). Theoretical bases of project management in conditions of innovative economy based on fuzzy modeling. *Journal of Physics*, 1015(3): 032013.

Ji, T. (2004). Consumer credit delinquency and bankruptcy forecasting using advanced econometrc modeling.

Korol, T. (2011). Multi-criteria early warning system against enteprise bankruptcy Risk. *International Research Journal Of Finance And Economics*: 141-54.

Kumar, P. R. and Ravi, V. (2007). Bankruptcy prediction in banks and firms via statistical and intelligent techniques–A review. *European journal of operational research*, 180(1): 1-28.

Mcleay, S. and Omar, A. (2000). The sensitivity of prediction models to the non-normality of bounded and unbounded financial ratios. *The British Accounting Review*, 32(2): 213-30.

Nwogugu, M. (2007). Decision-making, Risk and corporate governance, A critique of methodological issues in bankruptcy, Recovery prediction models. *Applied Mathematics And Computation*, 185(1): 178-96.

Tahavieva, F. R. and Nigmatullina, I. A. (2017). Speech-communicative function in the structure of predictive competence of young schoolchildren with musculoskeletal disorders. *Astra Salvensis*, 10: 315-22.