SHORT NOTES

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MODELING OF ENTERPRISE INNOVATION ACTIVITY IN TERMS OF "VYSOTA 239" JSC "CPRP"

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The paper is devoted to the author's evaluation innovation activity model tested in terms of "Vysota 239", implemented by JSC "CPRP". The key-question deals with the methodological problem in modeling framework determination. It has been solved in the process of innovation effectiveness evaluation. The authors implemented principle of comparability in terms of the prospective and retrospective horizons duration. A limiter is the point when financial results of project implementation achieves a positive zone. The limiter is specific for each innovative project. Modeling is carried out by a programming language "R", adjusted for the effects of factors multicollinearity through the mechanism of ridge regression.

Keywords: economic and mathematical model, an innovative project, innovative activity evaluation, ridge regression.

Introduction

The external environment of an organization is extremely aggressive and quite unpredictable under present instable economic and political conditions. In this context any innovative project implementation and investment is at risk and is quite difficult to perform. In this situation economic and mathematical models of enterprises innovation activity should become an effective management tool.

It determined the relevance of developing a method for assessing and predicting the industrial enterprise innovative activity results on the basis of the resultant operational indicators modeling.

1. Mathematical model

The initial stage of a prediction is the Cobb-Douglas production function calculations (1), including physical resources used at production output and "autonomous" technical progress Hicks-neutral [1]:

$$CP = A \cdot LCF^{\alpha} \cdot FA^{\beta} \cdot CA^{\gamma} \cdot e^{\lambda \cdot t} \tag{1}$$

where CP (commercial product) means commercial output, measured in thousand rubles per year; LCF is a labor compensation fund, measured in thousand roubles per year; FA (fixed assets) is the amount of basic production assets turnover, measured in thousand rubles; CA - current assets, measured in thousand rubles per year; A represents an empirical coefficient which conjugates the function composite elements (right and left parts) and equally performs as a scaled coefficient of reduction for each composite element

(1); α, β, γ - are the output elasticities of the correspondent assets and the output, numerical; e - base of the natural logarithm; λ coefficient of elasticity, showing the effect of "autonomous" technical progress on production results, numerical; t time valuated relatively to the base year, year, $(t_i = T_i - T_b)$.

The production function parameters $A, \alpha, \beta, \gamma, \lambda$ based on historical data CP, LCF, FA, CA, t using the methods of correlation and regression analysis [2].

There are two models (1) in order to evaluate the innovation activity of an industrial enterprise. The first one deals with the period 3 years before the innovation project implementation. The second one deals with the period 3 years after having executed the project. The difference of the production final rates $\Delta CP = CP_i - CP_{i+1}$ represents the particular innovation project execution.

Innovational activity of an enterprise (IA), considered within the frames of the particular innovational project is evaluated according to the sum of dynamics of production elasticity within the review production period [2]:

$$IA = (\alpha_{i+1} - \alpha_i) + (\beta_{i+1} - \beta_i) + (\gamma_{i+1} - \gamma_i) + (\lambda_{i+1} - \lambda_i)$$

2. Testing of the mathematical model

The industrial output elasticity coefficient calculations and models development (1) are based on in the official financial statements. It simplifies the practical realization of the proposed method. The quarterly statement reports were used to improve the modeling verifiability. The modeling results are shown in Table 2.

In terms of valuation innovation activity evaluation of JSC "CPRP" appeared a methodological problem at implementation of investment project at floor "Vysota 239". The problem deals with choosing modeling time horizon - m. Guided by the fundamental principle of methodology for the investment projects effectiveness evaluation (to ensure comparability of the options under consideration), the same retrospective and prospective durations of modeling horizons were adopted. A limiter is the point when financial results of project implementation achieves a positive zone. The limiter is specific for each innovative project.

The cost of the innovative project "Vysota 239" investment stage, which included the steps of preparation, direct realization (construction) and pre-commissioning activities, has paid off in 3 years. The model "before", based on the data for the three years prior the preparation for the draft Model "after". The model "after" is based on figures for 3 year period after the start of commercial operation. Calculation of the parameters of the production function performed by least squares in the medium programming language "R", with the adjustment coefficients for the effect of multicollinearity, through the mechanism of ridge regression. Results are presented in Table 1.

The negative coefficient of the FA in the model "before" indicates that in the retrospective period, the company operated on outdated material base. The revenue growth was driven by external factors (growth in the industrial market and the economy as a whole). The significant growth of the coefficient on FA and its approaching the zone of positive values in the model "after" suggests that the implementation of the innovative project has changed the company capital structure and improved significantly the utilization of fixed assets. However, it has led to an increase in labor costs of the staff recruited to work on a new production. This information can be regarded by the enterprise

management as an indicator, giving the direction for further efforts in reducing costs and improving efficiency.

The innovation activity coefficient for JSC "CPRP", which describes the result of the investment project "Vysota 239" implementation was calculated on the basis of the data produced in the process of modeling:

$$IA = (-0,12 - 0,37) + (-0,06 - (-2,27)) + (0,60 - 0,15) + (0,01 - 0,02),$$

$$IA = 2,16$$

Table 1

Parameters of production functions before and after the innovative project introduction.

	lnA	$\alpha(lnLCF)$	$\beta(lnFA)$	$\gamma(lnCA)$	$\gamma(T)$
Model "before"	45,25	0,37	-2,27	0,15	0,02
Model "after"	8,44	-0,12	-0,06	0,6	0,01

Table 2

Results of innovative activity modeling for JSC "CPRP" under the project "Vysota 239" implementation.

Project stage	Selection for model	Month	Year	CP, thou.roub.	FA, thou.roub.	CA, thou.roub.	LCF, thou.roub.
12	2004	3489721	10999651	7900826	179323		
3	2005	4154640	10873699	7455481	202105		
6	2005	4464124	10838994	6657926	193559		
9	2005	5208650	10388667	6921701	186543		
12	2005	5249905	10341680	6056100	181384		
3	2006	5016542	10433309	5906792	238296		
6	2006	5713279	10191401	5509150	229707	Before project	Model "before"
9	2006	7621054	978059 5	5961658	219707		
12	2006	7542487	10176944	8686345	219361		
3	2007	8460780	10617030	7576010	306611		
6	2007	9119973	10086519	10400457	285142		
9	2007	7492656	10269561	10409821	278570		
12	2007	6852352	10236580	9945261	260391		
3	2008	4964563	10482119	10695009	306909	Preparation	
6	2008	5660574	12167181	9602932	273079		
9	2008	5365706	14109764	12303554	263605		
12	2008	5837027	21325234	12586646	307545		
3	2009	4257116	22274496	16713546	226392		
6	2009	3744821	22263861	17135621	209348	Implemen-tation	
9	2009	3963508	23299087	16083439	188823		
12	2009	4108452	24995512	15849049	176658		
3	2010	5675646	24679181	17289253	270792		
6	2010	5877858	28192671	18000347	265231		
9	2010	5935703	28520090	16288101	266882	Adjustment	
12	2010	7298394	29344313	15835706	258257		

End of Table 2

Project stage	Selection for model	Month	Year	CP, thou.roub.	FA, thou.roub.	CA, thou.roub.	LCF, thou.roub.
3	2011	10618437	28336385	20580522	357945	Operation	Model "after"
6	2011	11994005	28127700	23880090	363311		
9	2011	9452571	27169009	22439432	364735		
12	2011	7493549	31281823	18535634	375114		
3	2012	9261475	31868036	19087815	384344		
6	2012	10432582	31708593	22990470	372128		
9	2012	10536162	30394045	20874782	351680		
12	2012	11488431	30549050	20728861	347798		
3	2013	9366869	34242004	18740909	431575		
6	2013	10493979	34593848	20546725	431018		
9	2013	10412707	32797248	20522001	415217		
12	2013	9949229	31733710	19246606	415894		
3	2014	8660609	31906034	18110773	440460		
6	2014	10337089	30235551	19704422	428294		
9	2014	11011064	29625073	20299140	416720		
12	2014	14303408	30236810	20813996	410189		

Conclusion

1. The resulting coefficient IA represents the change in the enterprise innovation activity and the project impact on the resulting performance indexes of the enterprise as a whole.

2. The project "Vysota 239" implementation had a positive effect on JSC CPRP investment activity. It has increased the value at 216. The data evaluate the implemented project as an unqualified success.

3. Economic and mathematical modeling of an industrial enterprise on the basis of the production function allows not only to evaluate the results of already completed projects, but also to predict the outcome of projects under development. To do this, the target values of the company resulting performance are to be predicted. They will be received at the end of project implementation. Also it is important to calculate the target coefficient of the innovation activity.

4. Author's index of the enterprise innovative activity is recommended to include into key performance indicators for the company's management evaluation.

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   History of Neoclassical Distribution Theory. *History of Economics Review*, 2002, vol. 36, pp. 44–65.

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МОДЕЛИРОВАНИЕ ИННОВАЦИОННОЙ АКТИВНОСТИ ПРЕДПРИЯТИЯ НА ПРИМЕРЕ ПРОЕКТА "ВЫСОТА-239" ОАО "ЧТПЗ"

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Статья посвящена апробации авторской модели оценки инновационной активности предприятия на примере проекта "Высота-239", реализуемого в ОАО "ЧТПЗ". В процессе оценки эффективности инновации решена сложная методологиче-ская проблема определения горизонта моделирования. Авторами при реализации принципа сопоставимости, в части продолжительности ретроспективного и перспек-тивного горизонтов, в качестве ограничения принят момент перехода финансового результата при внедрении проекта в положительную зону, что является специфичным для каждого конкретного инновационного проекта. Моделирование проведено с использованием языка программирования "R", с корректировкой коэффициентов с учетом эффекта мультиколлинеарности с помощью механизма ридж-регрессии.

Ключевые слова: экономико-математическая модель, инновационный проект, оценка инновационной активности, ридж-регрессия.

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