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MANAGING INNOVATION IN VIEW OF THE UNCERTAINTIES

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Abstract

Study of the problems of uncertainty in innovation is at present the most up to date. Approaches to its definition, arranged primarily on the assumption and include the known parameters, which essentially is a game approach to the assessment. Address specific issues of governance of innovation in accounting uncertainty still remains open and the most relevant, especially when the innovation represented by one of the drivers of growth of national economies. This paper presents a methodological approach to determining the degree of uncertainty and an approach to the management of innovation through a system of mathematical modeling on the criterion of gross errors.

Keywords: Innovation; uncertainty; control; evaluation criteria of gross errors.

INTRODUCTION

Theory and practice of innovation has always been separately associated with the identification and risk analysis. Certainly, the risks as an economic category, characterized by absolutely everyone, without exception, the processes in business organizations, regions and states. However, there are varieties of risks, which are very difficult to predetermine, predict. Thus, these risks of innovation transformed into a state which is called uncertainty.

Another aggravating feature is the uncertainty of its continued growth. In part, this situation is associated with many factors, among which highlights the globalization, the complexity of schemes of interaction between agents of markets, the acceleration of technological progress and national innovation systems, the transition to the new technological order, etc. To date, no theory has gained little experience in working with the

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uncertainty, but, unfortunately, it is focused either on the technical areas of the economy, or reflect the issues of the economy as a whole.

Thus, the problem of evaluation and innovation management in the face of uncertainty remains unresolved and extremely topical in the intrinsic property of the global economy. This article provides an overview of the existing varieties of uncertainty in innovation, identifies approaches to clarify the results in the face of uncertainty, which have found wide opening in game theory, and presented a methodological approach, which allows a theoretical point of view closer to one of the problems of innovation management in consideration of their under conditions of uncertainty.

The research methodology is based on a three-tier approach, in which arrays of information collected on topical issues of innovation uncertainty, the analysis of this information in terms of its distribution and the account, after which it is possible to talk about simplifying the solution of such problems as the direction of innovation, determination of its trend assessment the development of reliable information needed to make informed management decisions.

Conditions of Uncertainty in Innovation

Formation and development of innovation at the state level, the region and the organization has many meanings. On the one hand, the question of development of economies and institutions and the state, creating new jobs, growing purchasing power, are filled with the budgets of different levels, and the other may be that the innovation will affect negatively to the economic system.

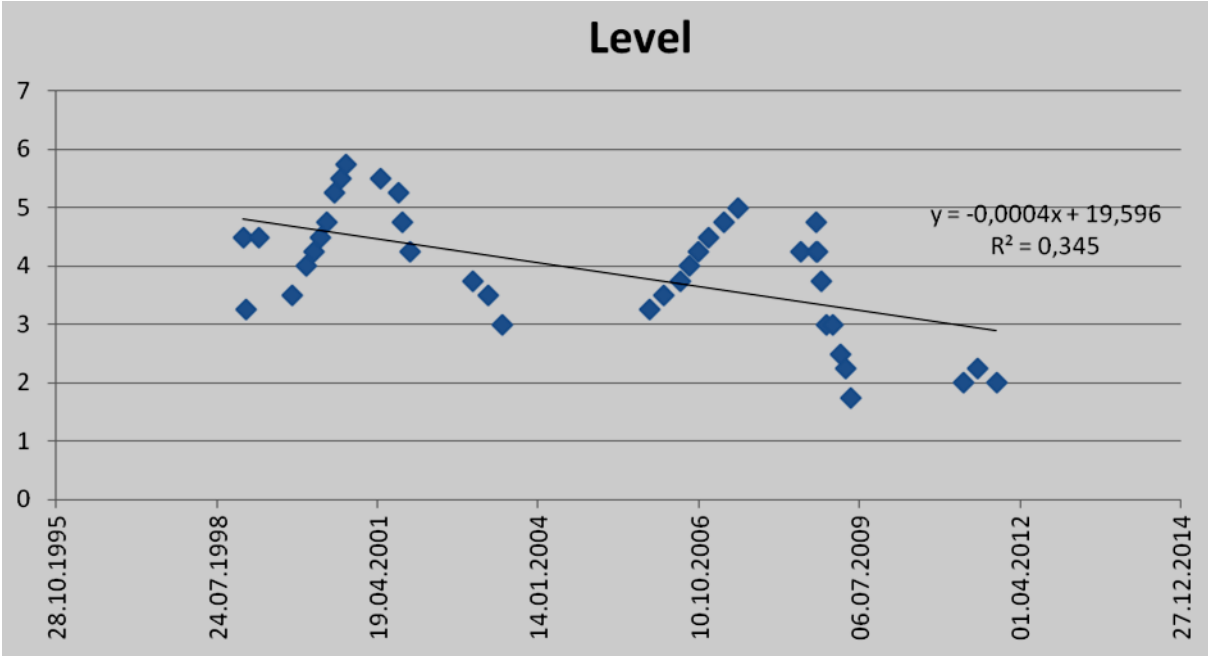
Typically, this occurs not because of the risks of a commercial nature or in efficient management, and for reasons trivial uncertainty, i.e. the absence of any - any information about future prospects. An innovative activity within an organization or region of the country has a number of properties of risk character. Calculated data showing effectiveness of the system under consideration of innovative measures in the commercial sector, based often on a purely financial results. In addition, a risk factor in the calculation only applies to the proposed discount rate, which is a priori assumed to be the refinancing rate or the average market rate of the bank loans to businesses.

The problem of this property is that the modern economic system of any country has the properties of turbulence, namely, the planning horizon ends in one year. Reliably determine the state of the economy in the next few years it becomes impossible, and thus the deviation from the intended result will be significant.

Thus, it appears that the inclusion of risk factors in the development of innovation is extremely difficult and is already receiving properties of uncertainty, the management of which is not as obvious as in the presence of risk. Thus, after analyzing data on marginal interest rates in the period from 1 January 1999 to 9 November, 2011. According to the ECB were reliably produced the following results:

FIGURE 1

Analysis of changes in interest rates



The value of standard deviation is 1.046; the coefficient of determination resulting linear model has a very low value and indicates that the standard error of the registration in the next forecast period will be not less than 66%. Also in the picture clearly shows signs of Heteroskedasticity at the inlet and outlet of the data being analyzed, it does not speak in favor of a reliable forecast for the next period. That's why rely solely approaches to the identification of risks through a series of financial and economic indicators are inappropriate.

In the same way you can describe almost any single-factor evaluation methodology. It becomes obvious that the development of innovation through the evaluation of the effectiveness of risk associated with deviations from the planned courses, which in turn develop into uncertainties. The presence of uncertainties may affect the effects of innovation, because there are no reliable data on the future status of the innovative projects and programs that are currently being accepted for implementation.

Uncertainty in the Innovation

In theory and practice to date are the following types of uncertainties in the innovation activities of commercial organizations (Jalonen & Lehtonen2011):

- Technology - is manifested in specific products and production processes (Harris & Woolley, 2009);
- The market - the most important aspect is the prospect of innovation in the market. Market uncertainty may arise at the stage of R & D, where no clear idea of the existence of further goals. In addition, innovation in consumer should have a positive response, and therefore, there are two launch it on the market, "ejection" where in parallel with the development and manufacture of innovative work going on to develop the necessary needs of potential consumers, "pull" - the production innovation in the light of those needs that are not implemented in real time or may be required in the future;
- Regulatory uncertainty - there are numerous gaps in the legal field of existence and development of innovations that could lead to its own rules of entrepreneurs, which does not necessarily mean support for social responsibility. In this case, are an issue of limitations and the availability of controllers for this type of uncertainty? Another point is the study of intellectual protection;
- Social and political uncertainty - as innovations emerges and develops under the influence of the market, which form a specific consumer, and reliance on social services to be available. Political uncertainty arises as a consequence of social uncertainty, i.e. through the conflicts of interests of social groups;

- The uncertainty of approval and legitimacy - the entry into dissonance with public order innovation (Wilson 1997) gives rise to many questions related to their acceptance and approval;
- The uncertainty of management - the problem is selection of specific instruments of influence on the risks and uncertainties that would have the effect of innovation. The problem of innovation management is the lack of guidance on accounting for all components that are associated with innovation and evaluation. This and issues of resource provision and management of people, finances, relationships with suppliers and customers, etc.;
- Uncertainty of timing (timing) - is the presence of stochastic factors when entering into the market innovations that could significantly affect its profitability and viability in the foreseeable future. As well there is the possibility of innovation in favor of rejection of ideas, time-tested. The presence of such a factor leads to unnecessary barriers and consumer rejection of innovation simply because they are new (McKinney 2011);
- Uncertainty of the consequences - is the inability to anticipate future outcomes of innovation. The results at the output of the system are difficult to see;
- Uncertainty of the specific innovation - depends on two types of uncertainty (Nedosetkin 2002), associated with lack of knowledge and vision for innovation.

Thus, it appears that innovation is not only connected to various risks, but with many uncertainties, which are the result of undervalued and unrecorded risk situations.

So, rightly raises the question of how to estimate the uncertainties of innovation in the spectrum of their multiplicity and heterogeneity?

In the literature are the following uncertainties in the system of innovation (Day 1997):

1. Changes in macro factors;
2. Changes in government regulation;
3. Changes in competitive behavior;
4. Changes in consumer behavior;
5. Technological change.

COMMON APPROACHES TO THE DETERMINATION OF UNCERTAINTY

In the practice of innovation management, innovation has to constantly deal with the conditions of uncertainty, making decisions that determine the further existence of the chosen direction of development.

The most popular solution to the uncertainty of game theory was based on an antagonistic contradiction, namely, the innovation it is important that the entrepreneur - his work is not an innovator inflicted harm anyone, but rather his work was a kind of driver of growth and development of competition and demand.

Among the most popular management theories uncertainties are the following:

-Maximax criterion

$$M = \max_i \times \max_j \alpha_{ij}$$

Using this criterion is difficult does not account laid adverse changes in the environment associated with innovation.

-Bayes criterion

$$BIC = -2\ln(l) + kLn(n)$$

-Akaikecriterion (Akaike1974)

$$AIC = 2K - 2Log(L(\hat{\theta}|y))$$

-Laplacecriterion (Nikulin1992)

$$W = \max_{i=1,\dots m} \frac{1}{n} \sum_{j=1}^{n} W_{ij}$$

-Wald criterion (Wald 1943)

$$W = \max_i \times \min_j \alpha_{ij}$$

Using this criterion is difficult as you may unreasonably reject the results, which have the potential effectiveness of innovations.

-Criterion Savage (Savage1972)

$$S = \min_i \times \max_j \times r_{ij}$$

The calculation results obtained by this criterion are focus on those effects, omission of which the most impact on the missdor misunderstood the decision.

-Hurwitz criterion (Hurwicz1951)

$$W = \max_{i=1,..n} \left[\alpha \max_{j=1,..m} W_{ij} + (1-\alpha) \min_{j=1,...m} W_{ij} \right]$$

This criterion is only a combination of approaches and maxmin & maxmax.

-CriterionHodge –Lehmann (Lehmann1996; Hodges & Lehmann1956)

$$\max_i e_{ir} = \max_i \left\{ n \sum_{j=1}^{n} e_{ij} q_i + (1-n) \min_j e_{ir} \right\}$$

-Criterion Greymer (Greymer1971)

$$\max_i e_{ir} = \max_i \times \min_j e_{ij} q_j$$

-Criterion of BL (MM)

$$e_{i_0 j_0} = \max_i \times \max_j e_{ij}$$

This criterion is a development criterion of Bayesa nd Laplace, but in practice its implementation is hampered by the definition of an array of information being processed and the duration of the study.

-Test works

$$\max_i e_{ir} = \max_i \prod_j e_{ij}$$

- Test works (Using this criterion in practice depends on finding a constant value, which in practice, innovation is almost impossible, especially when it comes to analyzing the innovation of the "first tier", i.e. having a radical.)

However, in practice the results of the decision designated games do not give a definitive answer on how to affect innovation in the overall efficiency in the commercial sector.

For example, the unanswered questions of interaction with the elements of internal and external environment. In addition to the above approaches of determining the uncertainty shown separately as the theory of fuzzy sets. However, its use in the management of innovation is almost useless, because of its intermediate values. In this case, game theory provides insight into the selection of some of the solutions presented during the calculation of alternatives, i.e., range or the maximum gain or minimum loss.

From a mathematical point of view presented by the formula, no doubt, are the workers, but their use may be hindered by the input parameters, namely, what data may be included in the calculation and how to reliably identify and present and prospective period.

Among other proposals for the management of innovations in the uncertainty at the seminar to support risky research (Elsum 2008) proposed guidelines for the development of institutional and personal factors. Of interest is the management of innovation in the structure of the uncertainty over the classification of the following development factors: the unknown and the unknowable (Chernykh 2008). According to the author, innovation Uncertainty must be configured through the use of criteria of gross errors.

PROPOSALS FOR THE DEVELOPMENT OF MANAGEMENT THEORY UNCERTAINTIES FOR INNOVATION MANAGEMENT

Thus, innovation is associated with many risks, which in turn smoothly into the region of uncertainty, prediction and evaluation are extremely difficult.

Introduction to the consideration of this criterion would eliminate gross errors in a large number of issues associated with fitting a large set of data for analysis. The results of innovative activities may have the following properties:

1. The results of the outliers;
2. The possibility of processing through the existing econometric methods.

We now turn to the formation of an algorithm taking into account the uncertainties in innovation. Initially, the researcher must prepare a specific set of statistics for each of the types of uncertainty. Issues of obtaining them can be individual and be in a sociological survey, expert opinion, or (if you can get) real statistical data.

Since initially we turned to the use of criteria of gross errors, then we can confidently assert that the results of innovative activities are subject to the normal Gaussian distribution due to underestimation of their own set of parameters, which is given by the function:

$$f(x)=\frac{1}{\sqrt{2\pi\sigma}}exp\left(-\frac{(x-m)^2}{2\sigma^2}\right)$$

Where m –is the expectation that specifies the maximum density;

σ2 -dispersion.

In this case, the distribution function of the results will be as follows:

$$\frac{1}{2}\left(1+erf\left(\frac{x-m}{\sqrt{2\sigma^2}}\right)\right)$$

Then the mass exponential distribution as x → ∞takes the following form:

$$\frac{1}{2}e^{\frac{(x-m)^2}{2\sigma^2}}\left(e^{\frac{(x-m)^2}{2\sigma^2}}\left(\frac{1}{\sigma^2}\right)^{\frac{1}{2}\left|\frac{\arg\left(\frac{m^2}{\sigma^2}-\frac{2mx}{\sigma^2}\right)}{2\pi}\right|+\frac{1}{2}}\left(\sigma^2\right)^{\frac{1}{2}\left|\frac{\arg\left(\frac{m^2}{\sigma^2}-\frac{2mx}{\sigma^2}\right)}{2\pi}\right|+\frac{1}{2}}+\left(-\frac{\sqrt{\frac{2}{\pi}}\sqrt{\sigma^2}}{x}-\frac{m\sqrt{\frac{2}{\pi}}\sqrt{\sigma^2}}{x^2}+\frac{\sqrt{\frac{2}{\pi}}\left(\sigma^2\right)^{3/2}-m^2\sqrt{\frac{2}{\pi}}\sqrt{\sigma^2}}{x^3}+\right.\right.$$

$$\frac{3m\sqrt{\frac{2}{\pi}}\left(\sigma^2\right)^{3/2}-m^3\sqrt{\frac{2}{\pi}}\sqrt{\sigma^2}}{x^4}+\frac{-\sqrt{\frac{2}{\pi}\sqrt{\sigma^2}m^4}+6\sqrt{\frac{2}{\pi}}\left(\sigma^2\right)^{3/2}m^2-3\sqrt{\frac{2}{\pi}}\sigma^4\sqrt{\sigma^2}}{x^5}+$$

$$\left.\left.\frac{-\sqrt{\frac{2}{\pi}}\sqrt{\sigma^2}m^5+10\sqrt{\frac{2}{\pi}}\left(\sigma^2\right)^{3/2}m^3-15\sqrt{\frac{2}{\pi}}\sigma^4\sqrt{\sigma^2}m}{x^6}+0\left(\left(\frac{1}{x}\right)^7\right)+e^{\frac{(x-m)^2}{2\sigma^2}}\right)\right)$$

Then the derivative will be the following:

$$\frac{\partial}{\partial x}\left(\frac{1}{2}\left(1+erf\left(\frac{x-m}{\sqrt{2\sigma^2}}\right)\right)\right)=\frac{e^{-\frac{(m-x)^2}{2\sigma^2}}}{\sqrt{2\pi}\sqrt{\sigma^2}}$$

Indefinite integral of the distribution of innovation, taking into account the error function is as follows:

$$\int\frac{1}{2}\left(1+erf\left(\frac{x-m}{\sqrt{2\sigma^2}}\right)\right)dx=\frac{1}{2}\left((x-m)erf\left(\frac{x-m}{\sqrt{2}\sqrt{\sigma^2}}\right)+\sqrt{\frac{2}{\pi}}\sqrt{\sigma^2}e^{-\frac{(m-x)^2}{2\sigma^2}}+x\right)+const.$$

The error function of x should be determined according to the tables of the error estimates given by the locations of errors. Thus, at this stage we have a certain set of values that can be called a "win" or "loss", depending on what subject to study.

3. Since the gross errors in the practice of research is not common (because they increase the variance of the results of the studies on the known parameters defined by interdependence, in our case, however, analyzed the flip side of such data), the most appropriate approach is to use exponential smoothing results using Holt-Winters (Winters1960),which was slightly refined in order to eliminate all kinds of random factors, the occurrence of which is inevitable in innovation:

$$\begin{cases} \Omega_t = \alpha \dfrac{Y_t}{S_{t-s}} + (1-\sigma)(\Omega_{t-1} - T_{t-1}), \\ T_t = \beta(\Omega_t - \Omega_{t-1}) + (1-\beta)T_{t-1}, \\ S_t = \gamma \dfrac{Y_t}{\Omega_t} + (1-\gamma)S_{t-s}, \\ \widehat{Y}_{t+p} = (\Omega_t + pT_t)S_{t-s+p.} \end{cases},$$

Where α, β, γ–constant lying in the range [0, 1], which should be selected by trial and error, which would achieve an optimal result, which would satisfy the requirements of the researcher.

Using this model will lead tote following problems:

-The probably exception of seasonal and structural vibrations;

- Identify indicators of T and S -values of the smoothed trend and seasonality, denoted by Ω.

3. Further work with the analysis of the data is reduced to a visual examination the direction the trend line in the Cartesian coordinate system, which allows you to select one of the possible forms of models, which can take one of the options: a linear or exponential, logarithmic, etc.

The choice of the model, as well as an overall assessment of its significance and each of its members is checked by the general rules of econometric analysis.

Following the procedure in the resulting model can be entered values, which in the opinion of the researcher are crucial in the development of innovation, or on which he wants to model the system state and defines a set of strategic actions that will address the following key tasks:

1. Get rid of the uncertainty;
2. select the strategic steps in the development of innovation;
3. Establish a system design and implementation of management decisions to achieve their goals.

CONCLUSIONS

Thus, based on the analysis of literary sources and methodological approaches, proposed a system of innovation management in the face of uncertainty. Based on the assumption that the results of a poll, statistics and expert assessment of the property will have a Gaussian distribution, we have derived the distribution of the domain of innovation, on which you can identify each of the necessary types of uncertainty.

To eliminate scatter and smoothing the overall results was proposed methodology Hold – Winter's, enhanced inclusion of the operator to reduce the effects of the so-called seasonality.

The results obtained in the second phase of the study will facilitate further research in the management of innovation through the assessment of the trend of its development, the definition of the model on which it will be evaluated, etc. Thus, presented a holistic approach, allowing us to reduce complex socio-economic and institutional factors to a minimum and build a system of governance in the face of uncertainty, which will be installed.

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