ECONOMIC MATHEMATIC-STATISTICAL MODELLING OF INVESTMENTS DISTRIBUTION IN UZBEKISTAN

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Introduction

There is a great necessity of science based forecast of economic proceeding in elaboration of our country future documentations and development of world economic integration.

According to the reports of the First president of the Republic of Uzbekistan, I.Karimov, “there is a great necessity to forecast the organization of production process – from starting of refinement of raw materials, till getting finished product…”’. If we speak about full understanding of forecast, there is a necessity of full understanding and learning all its laws in order to get better quality of predictions.

Forecasting is a special science of elaboration, definition of future developments which is fulfilled only on the basis of science. Besides, forecasting shows what can happen in the future beforehand (Ilichenko, 2006). We need to take note, that first of all, it is needed to plan all actions basing on proper forecast.

Literature Review

Many scientists conducted researches on "Investment activity" (Goncharuk, 2015) and "Marketing strategy" (Goncharuk and Getman, 2014), but they were considering only a portfolio of securities (Dash, 2017; Vishwas and Sivakumar, 2016). So Ding and Li (2008) gave the solution to the investment timing problem as a function of parameters, in particular, of the tax holiday duration and interest rate for borrowing. They had studied the question whether the higher interest rate for borrowing could be compensated by tax holidays. Startseva (2004) researched a principle of reducing indeterminacy during management decision making, due to the use of additional objective information, which could be found in special diversified corporation. She suggested Evolution forecast economic mathematical model (EMM). Jiuying (2007) and Yinsheng et al. (2010) showed that the mathematical problem of optimally managing portfolio of securities had received considerable research attention in recent years. Most of such researches had been concerned with the classical economic objective of maximization of expected utility of terminal wealth and/or utility of consumption over a planning horizon that could be finite or infinite. The asset appreciation rates and volatilities in all of these studies were constant, thus, the so-called “investment opportunity sets” were constants (Jiuying, 2007; Yinsheng et al., 2010).

Following the idea by Ma et al. (2010), if there is no accurate prediction, investors not only couldn’t obtain expected profits, but also aggravated the fluctuation of macroeconomic indicators.

However, the researches in these papers are made in the areas of investment timing problems and power industry investments, so they didn’t learned purposes in attracting and use of investments as an achievement of leading positions in economic development.
Research Methodology

Besides, forecasting in Uzbek language means “prediction”, but from our point of view, it is not allowed to consider these two expressions as the same. Because forecasting – has a probability character, with development of objects and accidents, and the spheres of its application are very wide, such as: geography, geology, ecology, economics, social, political and juridical spheres etc.

Hence, the object of this science is elaboration. Economic forecasting first of all is a process, which is aimed to the development of economic systems, through making economic forecasting based on scientific economical laws.

During achieving these objectives all possible situations are forecasted. Chosen development types, as the most effective, are used as information basis in creation of complex programming which could be used as necessary actions in future.

Further, expanding science plans in achievement of one in many directions of definite plan programs or the complex of programs considers through inspection. This plan gives an opportunity to choose and to prove sequence of terms to carry out economic actions. It is necessary to keep in mind, that we use system analysis because of the complexity and the large-scale of economic system.

Figure 1. Principles of System Analysis in Economy

**Source:** developed by author

Hence, particular features of analysis showed on the picture define an expediency of carrying out a number of logical stages for forecasting. Especially:

(a) to achieve the goal we need to carry out correlation analysis and to identify interrelations;

(b) to use factors identified through analysis arranging regression equation;

(c) arranging equation being evaluated through a number of criterion such as...
Fisher, Student, Durbin-Watson, etc. (Berejnaya and Berejnoy, 2005); (d) if equation corresponds to all criterions, we will forecast definite index.

Hence, taking into consideration of complexity of economic objects and processes, it is appropriately to use extrapolation method of forecasting on the basis of perspective development of economic objects and processes in future, which gives a chance of learning circular factors of research object.

The main reason for it is that extrapolation method usually based on forecast of time rows, and also modelling methods of time rows, dynamic rows of economic indexes.

On the basis of above-mentioned ideas, we analyse rate of dynamic rows of GNP and future amount of production in Uzbekistan in 1995-2015 years, and also a number of influential factors, such as investment amount, employment by branches, quantity of enterprises and inflation rates.

The Results

For proper working out of economic model of changes in GNP of Uzbekistan, first of all, it is needed to make correlation analysis. According to it, the chosen investments in relation to GNP (0,998835), fixed funds (0,966626) and changes of employed in economy (0,946714) were identified to be very closely interconnected. However, the factor of inflation with GNP factor are inversely (-0,72214).

As a result of our research we get multi-element model of GNP changes:

\[ \begin{align*}
Y &= 8241.7602 + 4.0027823 * X_1 + 0.0374589 * X_2 + 0.4141966 * X_3 - 1040.622 * X_4, \\
\end{align*} \tag{1} \]

where \( X_1 \) – investments to fixed capital; \( X_2 \) – fixed capital; \( X_3 \) – amount of employed people in economy; \( X_4 \) – inflation rate.

Now, to solve above-mentioned elementary models, we need to arrange models related to each factor and they look like:

\[ \begin{align*}
X_1 &= 7342.507619 + 2279.606786*t; \\
X_2 &= 4501.68 + 1637.996*t; \\
X_3 &= 8556.989 + 279.7614*t; \\
X_4 &= 7.586667 - 0.07*t. \\
\end{align*} \tag{2-5} \]

Then, we put models of factors changes into formula (1) and make forecast for chosen factors amount (Table 1).

<table>
<thead>
<tr>
<th>Year</th>
<th>GNP (bn) Y</th>
<th>Investment to fixed capital (bn)</th>
<th>Fixed capital (bn)</th>
<th>Total amount of employed people (thousand)</th>
<th>Inflation rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>183098,3</td>
<td>43606,6</td>
<td>24982,3</td>
<td>13592,7</td>
<td>6,12</td>
</tr>
<tr>
<td>2017</td>
<td>194803,9</td>
<td>46437,1</td>
<td>26620,2</td>
<td>13872,5</td>
<td>6,05</td>
</tr>
<tr>
<td>2018</td>
<td>206509,5</td>
<td>49267,6</td>
<td>28258,2</td>
<td>14152,2</td>
<td>6,01</td>
</tr>
<tr>
<td>2019</td>
<td>218215,1</td>
<td>52098,1</td>
<td>29896,2</td>
<td>14432,0</td>
<td>5,90</td>
</tr>
<tr>
<td>2020</td>
<td>229920,7</td>
<td>54928,6</td>
<td>31534,2</td>
<td>14711,7</td>
<td>5,84</td>
</tr>
</tbody>
</table>

Source: author’s working out based on data of Uzbekistan Statistics Committee
According to Table 1, the amount of investments to Uzbekistan economy in 2016 was 43606,63 and hence, when level of inflation averaged 6%, the amount of investments will be 1809011,6 bn, which in comparison with 2015 year grew by 7,8%.

In 2020 expected amount of investments to fixed capital will be 54928,6, under consistent, steadily carrying out reforms of modernization and diversification of economy in 2015-2019, amount of GNP will be expected 229920,7 bn.

Of course, achievement of such positive growth (31534,2 bn), can be explained as an amount of fixed funds and employment at 14711,7 thousand people. This situation in comparison with last year will be expressed as 27,4% and 12,7% growth, correspondingly. Besides, we mean development of consistent carrying out reforms in every branch, their unity in economic partnership. Because, in such a difficult situation nowadays, it is necessary to refuse old views and inertial methods of development for further prevention of rapid decrease of demand and keeping uncertainty in world market.

During present conditions of globalization all over the world, one of the main tasks of our government is to assure steadily technical and technic renovation of production, looking for internal opportunities and reserves, based on deep structural changes in economy, which means full development of industrial sphere.

For this purpose, it is necessary to repeat step by step all processes of forecasting Uzbekistan’s GNP volume. The factors influencing the production branches are:

- $X_1$ – investment involved with industry;
- $X_2$ – an amount of employed people in industry;
- $X_3$ – an amount of functioning enterprises in industry;
- and $X_4$ – rate of inflation.

Based on these determinations we work out economic models satisfying changes of factors related to time. According to them:

$$X_1 = -2867.28 + 763.603^t; \quad (6)$$
$$X_2 = 960.1316 + 33.55263^t; \quad (7)$$
$$X_3 = 983.5737 + 33.2406^t; \quad (8)$$
$$X_4 = 7.586667 - 0.07^t. \quad (9)$$

Through above-mentioned models, using the method of insertion instead of $X_1$, $X_2$, $X_3$ и $X_4$ factors, we identify the results of expected amount of products of industry sphere in Uzbekistan:

$$Y = -36611.32839 + 4.880186504^t X_1 - 257.9451398^t X_2 + 292.3053756^t X_3 + 313.50498^t X_4. \quad (10)$$

Then, we insert expressions and get the results, which should be composed into the Table 2.
Table 2. The Forecast of Expected Volume of Gross Product of Industry of Uzbekistan

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross volume of industrial products, Y (bn)</th>
<th>The volume of investment (bn) (X_1)</th>
<th>Amount of employed people (X_2), thousand</th>
<th>Amount of enterprises (X_3), thousand</th>
<th>Inflation rate, (X_4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>91708.1</td>
<td>13168.4</td>
<td>1664.7</td>
<td>1681.6</td>
<td>6.12</td>
</tr>
<tr>
<td>2016</td>
<td>96474.3</td>
<td>13932.0</td>
<td>1698.3</td>
<td>1714.9</td>
<td>6.05</td>
</tr>
<tr>
<td>2017</td>
<td>101240.6</td>
<td>14695.6</td>
<td>1731.8</td>
<td>1748.1</td>
<td>6.01</td>
</tr>
<tr>
<td>2018</td>
<td>106006.8</td>
<td>15459.2</td>
<td>1765.4</td>
<td>1781.4</td>
<td>5.9</td>
</tr>
<tr>
<td>2019</td>
<td>110773.1</td>
<td>16222.8</td>
<td>1799.0</td>
<td>1814.6</td>
<td>5.84</td>
</tr>
<tr>
<td>2020</td>
<td>115539.3</td>
<td>16986.4</td>
<td>1832.5</td>
<td>1847.8</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Source: author’s working out based on data of Uzbekistan Statistics Committee

According to the data on the Table 2, the growth of functioning enterprises of industry sphere in 2016 year is 2% and it will come in total 1714.9 thousand, amount of employed people in industry reached to 1689.3 thousand people and volume of expected investment in compassion with 2015 year has grown to 5.8% and reached 13932.0 bn, expected volume of gross industrial product will raise to 96474.3 bn.

Conclusion
The reason of consistent carrying out of Program of industrial development in 2015-2019 years, we can predict that up to 2020 year the volume of attracted investments to industry will equated 16986.4 bn, in comparison with 2015 year the growth of employment will be 101% and the growth of full amount of enterprises will be 9.9%, the volume of industrial products production will be 115539.3 bn and it will be 26% more than in basis year.

Hence, we can make following conclusions, taking into consideration the objects of such theme and complexity of economic processes. It is necessary to use the extrapolation method based on perspective development of economic laws in future, which gives an opportunity to learn cycle factors of research object, based on invariability. The reason of it is that extrapolation method usually based on forecast of single size time index, and is also based on the method of single size time index modelling, single size time index dynamics and single size time index in whole.

References
Abstract
The main purpose of attracting and using investments is an achievement of leading positions in economic development and in World market with local products of Uzbekistan. There is no doubt that to achieve such targets there is a need to coordinate plans with forecasting results based on scientific researches. Hence, here in this article conclusions of effective use of investments on the basis forecast related to econometrics modelling of such indexes, as: GNP, basic funds, conditions of industrial investments, also, inflation rates and employment in the country were given.

Keywords: economic systems, GNP, inflation rates, model, investments, forecast, extrapolation