World Economics & Finance Bulletin (WEFB)
Available Online at: https://www.scholarexpress.net
Vol. 33, April, 2024
ISSN: 2749-3628,

EVALUATION INNOVATIVE DEVELOPMENT THE REPUBLIC OF UZBEKISTAN WITH FIXED EFFECT MODEL

Nuriddinov Zufar Akbarovich
Doctor of philosophy (PhD) in economic sciences , independent researcher of the Institute of personnel training and statistical research . Tashkent, Uzbekistan.
e-mail: zufarnuriddinov@mail.ru
ORCID:0000-0001-8219-028X

Article history:

Received: 7th January 2024
Accepted: 4th March 2024

Abstract:

The article examines theoretical and practical issues related to econometric modeling of the innovative development of the regions of the Republic of Uzbekistan. In particular, the influence of the innovative state of the regions on the country's economy is high, and the interdependence of these indicators has been shown with the help of an econometric model, and some recommendations have been developed in this regard.

Keywords: innovation, innovative development, model, modeling, econometric modeling, list data, fixed effect model, random effect model.

INTRODUCTION

The international global innovation index magazine publishes the ranking of the innovatively developed countries and the number of innovations created every year. In 2023, the position of the countries of the world according to the rating of the global innovation index is as follows (on a scale of 0 and 100): Switzerland (67.6), Sweden (average 64.2), USA (average 63.5), United Kingdom (average 64.4) and Singapore (mean 61.5). The innovative development index of about 132 countries is listed here, Kazakhstan (average 26.7), Uzbekistan (average 26.2), Kyrgyzstan (average 20.2) and Tajikistan (average 18.3) can be seen from the Central Asian region [1]. Measures are being taken to improve the position of the Republic of Uzbekistan in international rankings.

Due to the fact that special attention is being paid to the issues of economic independence of the regions in the process of socio-economic reforms in the country, the statistical evaluation and econometric modeling of the regional economy and social spheres , especially the innovative development , are of great importance. It is more effective to manage socio-economic processes of regions taking into account the characteristics of each region.

Wisely manage the regions in making various decisions on work , modern it is required to create a statistical information base , digital economy and an improved set of regulatory and legal documents . Inefficient decisions can be made due to lack of knowledge or lack of perfection. These mainly occur as a result of lack of correct statistical analysis and econometric modeling of socio-economic events occurring in the regions. That is why President Sh. Mirziyoev's address to the Senate and the Legislative Chamber of the Oliy Majlis declared that "2020 is the year of science, enlightenment and digital economy" [2]. Our research was conducted to partially address the above-mentioned issues.

LITERATURE REVIEW

For the purpose of econometric modeling of the innovative development of the regions of our republic, as a result of studying the research conducted by a number of foreign scientists, scientists of the Commonwealth of Independent States (CIS), and scientists of our country, we have achieved our own results, which are different from them.

From scientists of foreign countries:

In the study conducted by C. Hsiao, the theoretical and methodological econometric modeling, econometric research of list data, essence and theoretical aspects of models created on the basis of list data are presented [3].

In the research carried out by JM Wooldridge, he conducted an econometric analysis of data such as econometric analysis, the type of data used in econometrics, cross-sectional data, and list data [4].

In the literature written by Damodar N. Gujarati, topics related to the science of econometrics are widely covered and methodological instructions are given for econometric models based on listed data [5].

scientists of the Commonwealth of Independent States (CIS):

In her research, T.A. Ratnikova developed practical courses on econometric analysis of statistical

World Economics & Finance Bulletin (WEFB)
Available Online at: https://www.scholarexpress.net
Vol. 33, April, 2024
ISSN: 2749-3628,

data and econometric models using the "STATA" package based on statistical data [6].

E.A. Kolomak conducted a number of econometric analyzes based on listed data and explained econometric modeling theoretically [7].

The scientists of our country were used by the following in their scientific research:

Sh.I. Mustafakulov in his scientific works and manuals paid attention to the attractiveness of the investment environment and conducted an econometric analysis of investment factors based on listed data [8].

A.Sh. Bekmurodov, O.B. Sattarov, A.Kh. Tokhtaev, R.H. Bozorov used both constant and random effects models in their scientific article entitled "Influence of indicators in the GCI index on the increase in the volume of attracting foreign direct investments" [9].

Z.A. Nuriddinov also developed a modern study of list data, fixed and random effects models in his Doctor of Philosophy thesis on economic sciences, titled "Statistical assessment of the innovative development of regional economies and investment attractiveness" [10].

However, insufficient attention has been paid to the issues of econometric modeling of the innovative development of the regions of the Republic of Uzbekistan. From an econometric point of view, it is appropriate to carry out a number of scientific research works in this regard. Econometric application of the role of innovation in the economy of regions and factors affecting innovative development is especially important.

RESULTS

Statistical and econometric analysis methods are widely used in evaluating the economy of the country and its regions. However, the methodological and organizational possibilities of this analysis are not effectively used in studying the economic development of the country, especially the regions. This situation hinders their further socio-economic development. One of the important problems of the present day is the transition to the path of innovative development in order to achieve competitiveness in the world market due to technical and technological renewal of production, promotion of scientifically demanding sectors. The innovative way requires the development and implementation of new projects , investment, technical and technological renewal of production, structural changes in the country's economy. Particular attention is paid to the work carried out in order to attract investments in order to implement projects related to structural change of the country's economy, modernization of industries, technical and technological renewal.

Let 's do a statistical analysis of the issues mentioned above and econometric modeling, the following thoughts are related not only to their theory, but also to statistical practice . Especially in the region of my country is to study the innovative situation , including their development prospects .

World experience shows that innovation processes are effectively implemented and technologies and other scientific products are commercialized only in countries with a comprehensively developed innovation system. In this process, the participation of the state, the real sector of the economy and the support of the innovation activities of leading companies are important. After all, science is the basis of this integration mechanism, which ensures the technical development of the state and the socio-economic development of the society.

the author's research on econometric analysis : in the region of the analysis of innovative development In order to create an econometric model, a regression model of listed data was presented , and the main factors affecting the increase in the volume of innovative products of the regions were studied.

Many models usually have a one-dimensional structure. However, in practice, two-dimensional economic data (structures) are often used. In this case, one of the measurement units refers to individual economic units, and the second refers to one or another moment in time. Similar sets of two-dimensional statistics appear when observing a large number of objects over a period of time. Models based on two-dimensional data are called Panel data regression models in econometrics. When translated from English to Uzbek, the term "Panel" means "List".

Panel data regression models differ from time series regression or spatial regression. Its variables have two subscripts, namely:

$$y_{it} = a + x'_{it}\, b + u_{dog}$$

where i is the serial number of the observed object, t is the time period, a *is* a free term, b *is* a vector of regression coefficients, $x'_{it} = (x'_{1it}, x'_{2it}, \ldots x'_{kit})$ of the independent variable row matrix vector.

A random error model with one component (organizer) is often used in list data applications:

$$u_{it} = f_i + e_{it}$$

where f_i – unobserved individual effects, e_{it} – residual random errors.

World Economics & Finance Bulletin (WEFB)
Available Online at: https://www.scholarexpress.net
Vol. 33, April, 2024
ISSN: 2749-3628,

In this case, f_i does not depend on time and represents the characteristics (characteristics) of objects that are not included in the regression equation.

Enumerated data can have different structure. For example, listed data is balanced if existing economic units do not disappear and new units do not appear for each time point, otherwise, if not for all points in time, existing economic units disappear and new units appear, it is called unbalanced data. In unbalanced samples, different economic units are observed at different points in time. Such data is called dummy list data.

Listed data processing was carried out using the STATA package (program).

For this, first of all, we convert variables into natural logarithms.

Resultant symbol: *u(volume of manufactured innovative products)*

ln(inv.GOODS.)=log(inv.GOODS.)

Factor sign: x_1 *(innovation costs)*

ln(inv.exp.)=log(inv.exp.)

Factor symbol: x_2 *(investment in fixed capital)*

ln (inves .)= log (inves .)

We also include regions as a separate factor in the model, that is, we create an alternative variable representing the region and include it in the model and STATA We present the result of our model using the program below.

Results of regression or equation testing

Variables	Coefficient	Std . error	t -statistics	Probability P>|t|
Free limit	4.0716	0.5112	7.97	0.000
ln(inv.exp.)	0.4552	0.0805	5.66	0.000
ln(inv.)	0.2389	0.1191	2.01	0.048
Eastern	3.4475	0.3271	10.54	0.000
Central	2.1668	0.3508	6.18	0.000
South	-0.7066	0.3461	-2.04	0.044
Western	0.9548	0.3343	2.86	0.005
R^2	0.8921	-	-	-
AdjustedR^2	0.8843	-	-	-

Source: Computed by author based on STATA software.

$$\mathbf{lny_{it}=4.0716+0.9548D_{2t}-0.7066D_{3t}+2.1668D_{4t}+3.4475D_{5t}+0.4552lnx_{1t}+0.2389lnx_{2t}}$$

In the above regression equation, the positive effect of investments in fixed capital and innovative costs on the volume of innovative products was determined. Both factors are statistically significant at the 5% significance level (P>|t|) . According to the model, a 1% increase in investment leads to a 0.24% increase in innovative output. A 1% increase in innovation costs leads to an average 0.46% increase in innovation output.

ANOVA

A source of dispersion	Freedom Degree (DF)	Squares Sum (SS)	MS	F (6, 83)
Regression	6	564.789333	94.13155	114.34
Residual error	83	68.332963	0.82329	-
Total	89	633.122296	7.11373	-

Source: Computed by author based on STATA software.

In particular, two approaches are used to account for unobservable individual effects of economic units.

The first is the fixed effect model (*FE*), where f_i individual effects are considered as fixed unknown parameters of the model. This model is required to satisfy the following key assumptions:

– x'_{dog} – row vector of the value of specified regressors;

– a_i – free term;

– *b is* the column vector of the regression coefficient;

– e_{it} - satisfies the conditions of the classical linear regression model, in particular, it is normally distributed and is not correlated with x'_{it} (independent variables).

$$y_{it} = x'_{it} b + a_i + e_{it}$$

World Economics & Finance Bulletin (WEFB)
Available Online at: https://www.scholarexpress.net
Vol. 33, April, 2024
ISSN: 2749-3628,

In this, a_i - free terms reflect unobservable variables representing individual characteristics over time.

fixed effects model is expressed in the form of a matrix as follows.

$$y = x * b + z * A + e$$
(NT,1) (NT,K) (K,1) (NT,N) (N,1)

(NT,1)

The Least Squares Dummy Variable (LSDV) method can be used to estimate the parameters of this model, resulting in the following estimate for the parameters.

$$\hat{\beta}_{\text{LSDV}} = \begin{pmatrix} x'x & x'z \\ z'x & z'z \end{pmatrix}^{-1} \begin{pmatrix} x'y \\ z'y \end{pmatrix}$$

In specialized literature, it is called the estimate of the method of least squares with fictitious (male, female) variables included in the regression equation.

Results of regression or equation testing

Variables	Coefficient	Std . error	t -statistics	Probability P> |t|
Free limit	5.2441	0.5215	10.06	0.000
ln(inv.exp.)	0.4552	0.0805	5.66	0.000
ln(inv.)	0.2389	0.1191	2.01	0.048
R^2 within	0.6605	-	-	-
R^2 between	0.7889	-	-	-
R^2 overall	0.6321	-	-	-

Source: Computed by author based on STATA software.

$$\mathbf{ln y_{it} = 5.2441 + 0.4552 ln x_{1t} + 0.2389 ln x_{2t}}$$

The fixed effects model (Fixed effects model) as the 1st regression equation revealed a positive effect of investments in fixed capital and innovation costs on the volume of innovative products. Other indicators are the same, that is, the influence of factors on the result is taken into account.

The second is the random effect model (*rondon effect model – RE*), f_i are considered as random variables of the individual effects model and they are not correlated with residual terms. The matrix representation of this model is as follows:

$$y = x * b + u$$
(NT,1) (NT,K) (K,1)

(NT,1)

In this: $\begin{cases} u - normal\ distribution \\ x - matrix \\ E(u) = 0, because\ E(u) = 0, E(\varepsilon) = 0 \\ E(uu') = \Omega \neq \sigma^2 * I_{NT} \\ E(u_{it}\, u_{i't}) = \delta_{ii'}\sigma^2 + \delta_{it'}\delta_{tt'}\sigma_\varepsilon^2 \end{cases}$

here $\delta_{it'} = \begin{cases} 1, & i = i' \\ 0, & i \neq i' \end{cases}$ Kronecker symbol.

If the above assumptions are fulfilled, the estimates obtained by the method of generalized least squares for the parameters of the model are not shifted:

$$\hat{b}_{GLS} = (x'\Omega^{-1}x)^{-1}x'\Omega^{-1}y$$

Taking into account all the given expressions, we present the result of the random effects model using the STATA program.

Results of regression or equation testing

Variables	Coefficient	Std . error	z	Probability P> |z|
Free limit	5 . 2008*	0.8 25 7	6.30	0.000
ln(inv.exp.)	0.4819	0.0798	6.04	0.000
ln(inv.)	0.2092	0.1188	1.76	0.078
R^2 within	0.660 2	-	-	-
R^2 between	0.79 51	-	-	-
R^2 overall	0.6 416	-	-	-

Source: Computed by author based on STATA software.

$$\mathbf{ln y_{it} = 5.2008 + 0.4819 ln x_{1t} + 0.2092 ln x_{2t}}$$

The results of the random effect model also confirm the results of the fixed effect model, that is, in this model, it proves that investments in fixed capital and innovation costs have a positive effect on the volume of innovative products. The coefficients found are very close to the coefficients of the fixed effect model, and innovation costs are statistically significant at the 1% significance level, and fixed capital investments are statistically significant at the 10% significance level.

World Economics & Finance Bulletin (WEFB)
Available Online at: https://www.scholarexpress.net
Vol. 33, April, 2024
ISSN: 2749-3628,

As a result of the econometric evaluation of the parameters of the regression equations based on the used models, the reliability of all parameters was confirmed. We used the Breusch and Pagan Lagrangian multiplier test to check the validity of the regression equations themselves, the results of which are presented below.

Breusch and Pagan Lagrangian multiplier test

Estimated results	There is	std=sqrt(Var)
ln(inv.goods.)	7.1137	2.6672
prop	0.8233	0.9074
chi	2.0036	1.4155
Test:	Var(u)=0	-
	Chibar2(01)=16029	-
	Prob>chibar2=0.0000	-

l n (inv.goods .) [id,t] = Xb + u[id] + e[id,t]

The results of the Broysha-Pagana test above indicate that a random-effects model can also be applied to these data.

The advantages of models based on listed data are:

– a large number of objects are observed, resulting in an increase in the number of arbitrary levels and an improvement in the "effectiveness" of the sample estimate;

– Aggregate bias, which inevitably occurs in both time series and spatial data analysis, is eliminated;

– it is possible to observe the dynamics of various objects;

– it will be possible to analyze many important economic issues.

CONCLUSIONS AND SUGGESTIONS

In the current strategic economic conditions, great attention is paid to the innovative development of the regions. A lot of tasks are defined in several decrees and decisions of the President. The effective performance of these tasks requires a statistical evaluation of the innovative development of the regional economy in the republic.

Therefore, the following conclusions can be drawn based on the above-mentioned considerations:

factors affecting the innovative development of regions in the literature are different in terms of the number, direction, types, classification of factors, and some of them have proposals and opinions that are completely opposite to each other. In our opinion, the factors, first of all, should be divided into negative and positive, in turn, endogenous and exogenous factors, and they should be divided into innovative development factors;

based on the results of research conducted in the world countries' experience of econometric modeling of the innovative development of regions, we suggest using list data, fixed effect model and random effect model, which allow to achieve the most effective and quick result in practice;

the following conclusion was reached based on the listed data, fixed effect model and random effect models: the amount of investment in fixed capital and expenditure on innovation has a positive effect on the innovative products (work, service) produced. That is, according to the model, a 1% increase in investment led to an average increase in innovative output by 0.24%, and a 1% increase in innovation costs led to an average increase in this output by 0.46%;

with the help of built models, it is possible to develop forecasts for the republic, including regions.

Based on these conclusions, the following is suggested:

1. Improvement of the system of providing agricultural services based on science and innovation.

2. Establishment of innovative educational and production technology park "INNO" established in Tashkent city also in the districts transformed into innovation regions.

3. Adoption of production technologies of innovative products that create high added value in districts transformed into innovation areas.

4. Establish a mechanism for publishing the "Innovation-investment development rating of regions" and include the following:

the level of usefulness of innovative products created in the regions;

evaluation of the efficiency of investments attracted to the regions;

developing a system for creating innovative products based on the potential of regions;

attracting investments based on the principle of inclusive development of regions.

World Economics & Finance Bulletin (WEFB)
Available Online at: https://www.scholarexpress.net
Vol. 33, April, 2024
ISSN: 2749-3628,

LIST OF REFERENCES

1. https://www.globalinnovationindex.org/gii-2019-report#
2. President of the Republic of Uzbekistan Shavkat Mirziyoyev Address to the Assembly // "Word of the People" newspaper, 2020 January 25
3. Hsiao C. Analysis of Panel Data. _ Cambridge University Press, 1986.
4. Wooldridge JM Econometric Analysis of Cross Section and Panel Data, _ MIT Press, 2002.
5. Gujarati ND Basic Econometrics, fourth edition. 2004.
6. Ratnikova T.A. ANALYSIS PANELNYX DANNYX V PACKAGE "STATA" Methodological instructions for computer science practical course "Econometric analysis panelnyx dannyx". Moscow 2004.
7. Kolomak E.A. Econometric analysis panelnyx dannyx. — Novosibirsk: NGU, 2007.
8. Mustafakulov Sh.I. Attractiveness of the investment environment. Scientific and practical guide. BAKTRIA PRESS, TASHKENT 2017.
9. Bekmurodov A.Sh., Sattarov O.B., Tokhtaev A.Kh., Bozorov R.H. The influence of indicators in the GCI index on the increase in the volume of attracting foreign direct investment. " UzBridge " electronic magazine. Issue 2, October 2019, pages 3-11.
10. Nuriddinov Z. A. Statistical assessment of innovative development of regional economy and investment attractiveness. Doctor of Philosophy Dissertation in Economics. Institute of personnel training and statistical research under the State Statistics Committee of the Republic of Uzbekistan. Tashkent 2020