

REPUBLIC OF AZERBAIJAN

On the right of the manuscript

**OPTIMAL MANAGEMENT IN A MULTISECTORAL
ECONOMIC GROWTH MODEL**

Speciality: 5302.01 - "Econometrics, Economic Statistics"

Field of science: Economic sciences

Applicant: **Shafa Vagif qizi Bagirova**

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

BAKU – 2021

The dissertation work was done at the " Economic informatics and ecology" department of Lankaran State University.

Scientific supervisor: Honored Scientist, Professor
Doctor of Physical and Mathematical Sciences,
Asaf Dashdamir oghlu Isgandarov

Official opponents: Professor, Doctor of Economic sciences
Ramiz Kamal oghlu Isagandarov

PhD, of Economy, associate professor
Shafiga Safar qizi Mammadova

Ph.D. of Economy, associate professor
Aytakin Telman qizi Afandiyeva

Dissertation council FD 1.11 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at Azerbaijan State University of Economics.

Chairman of the

Dissertation council:



signature

Doctor of economic sciences, Professor
Yadulla Hamdulla oghlu Hasanli

Scientific secretary of the

Dissertation council:



signature

Doctor of philosophy in economics
Rashad Aktiv oghlu Huseynov

Chairman of the

scientific seminar:



signature

Doctor of economic sciences, Professor
Murad Ramiz oghlu Tagiyev

GENERAL CHARACTERISTICS OF THE WORK

Urgency of the subject and the degree of processing. In the modern global world economy the analysis of the concept of sustainable development within different prisms, both in theory and in practice, is important with the integration trends between the countries, the expansion of socio-economic and cultural relations. One of the main goals of the socio-economic policy pursued by each state, regardless of its social and economic structure, is to ensure sustainable development of the country. While the concept of sustainable development implies the efficient use of natural resources to meet the needs of the next generation, on the other hand, it puts the emphasis on human capital development, innovation, the application of new environmentally friendly technologies, and modernization of the economy.

Currently, one of the main issues before the country's economy is diversification of the economy. Let's take a look at President Ilham Aliyev's idea : "The diversification of the economy at this stage is one of the priority areas of our economic policy." But diversification of the economy is possible only in the case of a multi-sectoral economy. The division of the economy into various branches leads to its diversification. The scientific importance of the multi-sectoral economy is possible, especially in the real economy. The diversification of the economy also leads to multi-sectoral organization of the production. This, of course, falls on public and private enterprises. From this point of view, the study of economy in the direction of multi-sectoral economy is very urgent.

The concept of sustainable development that emerged in the last decade of the twentieth century is one of the most modern models of modern development that are directly aimed at human development. This concept encompasses all aspects of development - economic growth, investment, technology, infrastructure, international trade, social security, employment, tax policy and other areas of human development. Sustainable Development Strategy envisages such a model of development that, on the one hand, should be governed by appropriate social and economic policies and, on the other, should provide the foundation for future generations. In addition, a strategic

roadmap for the national economy and key sectors of the economy has emerged in connection with the non-oil sector. It is not only the development of small and medium-sized businesses in the economy, but also the growth of the private sector. The main feature of the Road Map is to minimize the dependence of Azerbaijan's economy on the oil sector and to balance this process.

The analysis of the socio-economic development processes in the global economy shows that sustainable economic growth is required, especially in the case of economic growth. At the same time, the optimal management of the multi-sectoral model of economic growth is of special urgency. It is known that determining the best distribution of national income is one of the main problems of economic policy. In recent years, Azerbaijan has made a number of successful steps towards the distribution of national income. The analysis of the dependence models of the main factors characterizing the dynamics of economic growth for the economic regions of the Republic of Azerbaijan using the methods of economic and mathematical modeling is very relevant.

The approach shown in these works has been applied to the analysis of economic systems. An attempt has been made to select the simplest and most typical of the studied model so that it is possible to observe the characteristic features of the processes analyzed in this model. In addition, the model studied allows us to observe the basic features of the corresponding real processes. Based on the principles of sustainable development in the regions, the study of the impact of investment in fixed assets, paid services and industrial output on one of the socio-economic indicators, and analyzing the effects of regression models on the development of the republic and regions is very urgent.

The goal and objectives of the research. A comprehensive analysis of the current socio-economic situation in Azerbaijan is based on a multi-sectoral model of economic growth to develop proposals and recommendations for determining sustainable economic growth and macroeconomic equilibrium and ensuring economic growth. At the same time, multi-sectoral organization of economy and production was taken as one of the steps towards the development of the non-oil sector in order to reduce the dependence of the economy on the oil and

gas factor. The models of dependence on the main factors characterizing the dynamics of economic growth for the economic regions of the Republic of Azerbaijan using the methods of economic and mathematical modeling are economic, econometric analysis, and the main factors influencing the development dynamics of the regions.

To achieve these objectives the following tasks have been proposed in the thesis :

- to develop theoretical bases of multi-sectoral production process management ;
- to determine the impact of investment programs on the dynamics of economic development ;
- to develop optimal management models in multi-sectoral production ;
- to identify the correctness of the issues of optimal capital investment ;
- to conduct statistical analysis of investments by economic sectors in the regions ;
- to create a regression model of interdependence between socio-economic indicators in the republic and regions ;
- to provide econometric and economic analysis of the results from the established models ;
- to perform the evaluation of models in the statistical program Eviews ;
- to check the adequacy of models established between socio-economic indicators in the country and regions ;
- to give hypotheses of established models.

Research methods. The research process is based on mathematical and statistical analysis, comparative analysis, econometric modeling, optimal control methods. Differential equations, optimal control theory, economic and mathematical modeling methods were used in the research.

The main provisions of the defense:

- Necessity of multi-sectoral production and its management;
- The main directions of multi-sectoral production in state and private institutions and the expected results;
- Optimal investment management through economic growth

models;

- Analysis of the dependence of socio-economic indicators on economic growth in the country and in some regions by means of regression models;

- Econometric and economic explanation of the models of regression evaluated for the Republic and its regions;

Scientific novelty of the research work. The major scientific novelties of the thesis are the follows :

- on the basis of multi-sectoral economic growth, optimal management programs have been studied and characterized;

- a methodology for optimal investment in sectors of the economy have been developed;

- the economic essence of the multi-sectoral organization of production in public and private enterprises on investment programs in the dynamics of economic development have been determined and evaluated;

- the impact and importance of State Programs in the development of the regional economy have been assessed;

- A model of the relationship between a number of socio-economic indicators in a number of regions has been developed and this model has been evaluated in the Eviews statistical program and specific recommendations have been made for the regions;

Theoretical and practical importance of the research. Impact of socio-economic development in the country through the development of optimal management programs based on the multi-sectoral model of economic growth, achieving certain results in the development of the non-oil sector by increasing the country's competitiveness. The methods and tools proposed in this work, and the optimal directions developed can enable the efficient use of the optimal management mechanism based on the multi-sectoral model of economic growth for sustainable economic development in the context of market relations. On the other hand, the scientific results and provisions from the research contribute to the use of multi-sectoral production capacities in public and private enterprises in the country, the application of the model of optimization in the dynamics of national economy development with the use of specially selected

investment programs. The practical significance of the research is that the results of the research and the generalized provisions of the dissertation can be used in the process of teaching the subjects of Econometrics and Economic Statistics.

Approbation and application. The main theoretical provisions of thesis and practical suggestions arising from research work have been published in the scientific journals registered by the SAC, which have been reported in scientific and scientific-practical conferences held in the Republic and abroad.

The results of the research and the generalized provisions of the dissertation can be used in the teaching process of "Econometrics" and "Economic Statistics".

The name of the institution where the dissertation was done.
Lankaran State University.

The total volume of the dissertation with a sign, indicating the volume of the structural units of the dissertation separately. The dissertation is in the volume of 117 pages consisting of introduction (12299 symbols), 3 chapters (chapters I – 47810 symbols, chapters II – 27187 symbols, chapters III – 52378 symbols), conclusion (5183 symbols), 11 pictures, 8 graphs, 21 tables and the list of references covering 124 sources used. The total volume of the dissertation is 144,863 characters.

Table of Contents of the Thesis

Introduction

Chapter I. Theoretical basis of management of the multi-sectoral production process

1.1. Multi-sectoral production process and its management

1.2. Necessity of multi-sectoral production in state and private enterprises

1.3. Investigation of impact of investment programs to the economic growth dynamicsf

Chapter II. Optimal management of multi-sectoral production

2.1. Optimal management models in multi-sectoral production

2.2. Correctness of the optimal capital investment issues

2.3. Necessary condition for differentiation of quality criteria and settlement of optimal management issues

Chapter III. Ways of improvement of multi-sectoral regional economy

3.1. Role of State Programs in socio-economic development of Azerbaijan Regions

3.2. Comparative analysis of capital investments in economic sectors in the regions .

Conclusion

References

SUMMARY OF THE THESIS

The issues set forth in the thesis have been settled within the framework of major provisions given below.

1. Necessity of multi-sectoral production and its management.

Socio-economic development continues in the modern era, when Azerbaijan's level of integration into the world economy rises. This development took place as a result of the more effective use of the real opportunities of the economy of the republic, as a result of the implementation of the correct political course and well-grounded scientific programs in the country. [13,24,69].

In the modern world, the economy of our country has created a favorable environment for global multinational corporations to operate and their foreign direct investment. According to the classification system of the SSC of the Republic of Azerbaijan, the real sector producing products include agriculture, hunting, forestry and industry. Construction and services include communications and transportation, postal, social and other services.

Sectors highlighted in the Strategic Roadmap for the perspective of the National Economy of the Republic of Azerbaijan, approved by the Presidential Decree dated 06.12.2016 is of important urgency. Not all of these sectors are high in value added to GDP. The development of eight priority sectors, taking into account the potential of the national economy of Azerbaijan, is one of the main issues in the modern world. 4 of these sectors envisage sustainable development of manufacturing sector - oil and gas, agrarian sector, production of consumer goods at the level of private entrepreneurship, heavy industry and mechanical engineering.

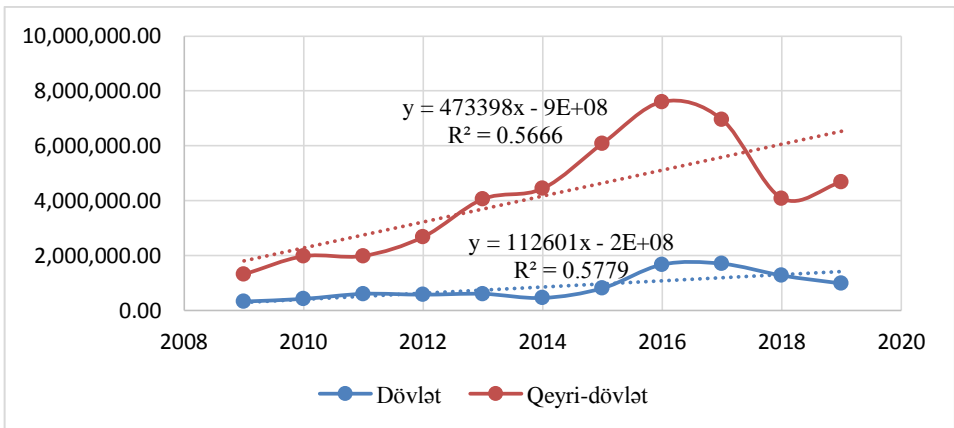
Table 1.

Investments on oil and non-oil sector (in mln USD)

	1995-2002	1995-2015	2015	2016	2017	2018	2019
On oil sector	7007.7	79953.4	9328,8	6983,4	6959,2	6701,1	5936,0
On non-oil sector	5466	139262.8	10218,4	7244,6	7254,1	8520,6	8762,0

As seen from the Table 1, Investments in the Oil Sector in 1995-2002 were US \$ 7007.7 million, while in 1995-2015 this figure was USD 79953.4 million. While the investments in the non-oil sector in 1995-2002 were \$ 5466 million, in 1995-2015 this figure was \$ 13,9262.8 million. Total investments on the oil and non-oil sector in 2019 decreased by 13219.5 million US dollars compared to 2014. These dynamics played an important role in the formation of multi-sectoral production in the country.

Although investments in the private sector are less than public investments, there has been an increase in investments in this area recently (Figure 3.2.1).



Graph 3.2.1. Distribution of foreign investments in fixed assets by property type (in thousands of manats)

Source: [120]

According to statistics obtained in 2019, the volume of the private sector in GDP was 84%, and employment was 80%. Evidence of the state's assistance to entrepreneurs is that more than 19,200 new jobs have been created. The share of GDP per capita was 8247.0 manats. Despite decreasing oil prices and volatile exchange rates, the main reason for the increase in foreign exchange reserves is the development of the non-oil sector. Despite the scale of the crisis in

the world, the Azerbaijani economy has been able to maintain its line of development [120, 121,124].

One of the main tasks for the implementation of the economic development strategy is to reduce dependence on oil and achieve the development of other sectors of the economy and regions in Azerbaijan. In January 2019, the volume of industrial output in the country reached 46.7 billion manats, and the volume of agricultural production reached 976.7 million manats. The increase in domestic production not only created an abundance of products in the domestic market, but also created opportunities for increasing the export potential of the national economy [26].

2. The main directions of multi-sectoral production in state and private institutions and the expected results.

In our Republic, there are many opportunities for multi-sectoral production in public and private enterprises. Government support for new economic projects and accelerated economic development will make these opportunities more accessible. With the introduction of new technologies, the economic potential of the republic is further strengthened by the revival of traditional areas and the more efficient use of local resources. In 2019, the volume of GDP in Azerbaijan increased by 2.2% and amounted to 81681.0 million manats. 33815.9 million manats of GDP produced in industry, 8168 million manats in trade, In the repair of vehicles, 5962.7 million manats in construction, 4900.86 million manats in transport and warehousing, 4655.8 million manats in agriculture, forestry and fishing, 1960.3 million manats in tourist accommodation and catering, 1470.3 million manats in information and communication , 13640.7 million manats in other areas.

As a result of multi-sectoral production in public and private enterprises, with the modernization and diversification of multi-sector production in public and private enterprises, it is expected for achieving similar results to transform multi-sector production into the main source of economic growth, to increase the share of regions in multi-sector production in public and private enterprises, to provide new jobs in multi-sectoral production in public and private enterprises mainly through opening of medium and high-tech enterprises, to expand international standards in multi-sectoral production, the form of an

improved legislative framework for multi-sectoral production in public and private enterprises and others.

3. Optimal investment management through economic growth models.

The generalization of the neoclassical growth model is a bisectoral growth model. This model addresses two sectors of production with different technologies. Usually one sector produces the same investment products and the other produces similar consumption factors. If $Y_c(t)$ is the output of consumer factors and $Y_I(t)$ is the output of capital-intensive products, then the gross national product (GNP) of time t is equal to :

$$Y(t) = Y_C(t) + pY_I(t),$$

Here, p is the price of the means of production in the consumer unit. Each sector uses two factors — capital and labor — to produce products in the manufacturing process. Product release is determined by production function :

$$Y_j = F_j(K_j, L_j), \quad j = C, I,$$

Here, $K_j(t)$ is the cost of capital in the sector of H , and $L_j(t)$ is the labor used in this sector.

We have investigated the manufacturing process, which has a small number of sectors below [41]. Let's look at the sectoral economy that produces different products. Here is the output of the product, - the unit of cost of this product, - capital, - labor force, - productive function, - consumption, - capital deviation in the sector at any time. Here . It is assumed that the given production function meets the conditions of neoclassical economic growth. Then the total product released at the moment will be evaluated as follows : [48,92] :

$$Y(t) = p_1(t)Y_1(t) + \dots + p_n(t)Y_n(t) = \sum_{i=1}^N p_i(t)Y_i(t) \quad (1)$$

In all sectors, during i time, the total number of employees, total capital and total consumption will be concentrated on sectors :

$$L(t) = \sum_{i=1}^N L_i(t), \quad K(t) = \sum_{i=1}^N K_i(t), \quad C(t) = \sum_{i=1}^N C_i(t) \quad (2)$$

In future judgments, we will take into account that we assume that:

- 1) the transition of workers from one sector of the economy to

another has not occurred ;

2) $L_j(t)$ increase principle of number of the employees was given in each sector :

$$L'_j(t) = \beta_j L_j(t), L_j(0) = L_{0j}, t > 0 \quad j = 1, 2, \dots, N \quad (3)$$

here, $\beta_j > 0$ is the growth ration of the number of employees in j sector, L_{0j} - is the initial number of employees in this sector ;

3) The functionality of each sector depends on capital, labor, and time, it means

$$F_j = F_j(t, K_j, L_j), \quad j = 1, 2, \dots, N ; \quad (4)$$

4) the production function is declining and increasing function ;

5) As known, national revenue $Y(t)$ is usually divided into investment $I(t)$, consumption $C(t)$, state expenses $G(t)$, ecological costs $V(t)$, foreign economic operational costs $T(t)$:

$$Y(t) = I(t) + C(t) + G(t) + V(t) + T(t)$$

It does not investigate government spending, environmental costs, and the impact of foreign economic operations. They are considered fixed. Therefore, following the model given for simplicity, let us assume that the economy is limited, there are no public expenditures, environmental costs and foreign economic operating costs [49]. Keeping these costs in the form of fixations does not have any impact on future performance. National revenue $Y(t)$ is spent for investment $I(t)$, or consumption of population $C(t)$, it means

$$Y(t) = I(t) + C(t) ; \quad (5)$$

6) Initial capital investment in all sectors is known:

$$K_j(0) = K_{0j}, \quad j = 1, 2, \dots, N \quad (6)$$

here, K_{0j} - j -is the amount of the initial capital in the sector;

7) $u_j(t)$ positive function $Y(t)$ is the share of the national revenue in t time in the sector j -ci $j = 1, 2, \dots, N$ of the capital directed to net incomes of the capital and payment of depreciation costs.

Then, the following result is obtained from (1) and (4) :

$$Y(t) = \sum_{i=1}^N p_i(t) F_i(t, K_i(t), L_i(t))$$

If, $K'_j(t)$ function is reproduction of $K_j(t)$ -nin, it means if j of the capital is net increase in the sector, them the following relation is paid:

$$u_j(t) \sum_{i=1}^N p_i(t) F_i(t, K_i(t), L_i(t)) = K'_j(t) + \alpha_j K_j(t), \quad j = 1, 2, \dots, N, t > 0 \quad (7)$$

Here, $K'_j(t)$ is the production function. A number of important factors are essential for production. These factors include land-N, Capital-K, labor force-L, initiative- θ . These factors are the main factors. The function that shows the dependence of the amount of production on the production factors is called the production function [66,96].

$$y = F(N, K, L, \theta)$$

The quantity of the product is an F production function. Usually it is not possible to take into account the dependence of function N on the environment in which economic activity occurs. It is not always easy to evaluate the entrepreneurial factor involved in the production function. Thus, the most commonly discussed issue is the dependence of the production function on capital and labor force :

$$y = F(K, L).$$

The foregoing forms the basic link between the multi-sectoral economic development model considered. as seen from (5), (7) equation, the total consumption can be as follows.

$$C(t) = \left(1 - \sum_{j=1}^N u_j(t) \right) \sum_{i=1}^N p_i F_i(t, K_i, L_i)$$

(5) equation expresses the mutual relation of economic sector and constitutes main equation of the system :

$$K_j(0) = K_{0j}, \quad j = 1, 2, \dots, N$$

Here, K_{0j} - is the iniital capital in the sector. In case of multi-sectoral model (7) the equation is the analogue of the well-known Solou equation of the bisectoral economic model [33].

4. Analysis of the dependence of socio-economic indicators on economic growth in the country and in some regions by means of regression models.

Depending on the main factors characterizing the dynamics of economic growth for the economic regions of the Republic of Azerbaijan using the methods of economic and mathematical modeling, the following models can be analyzed. The principles of sustainable development by regions are analyzed by regression models, depending on the volume of investment in fixed assets, paid services and industrial output, which is one of the socioeconomic indicators [102,112]. As an additional explanatory variable to enhance the adequacy of the valued models, the world market price of Brent oil is also included. To make the comparative analysis of the results of these models more complete, the assessments were conducted both nationally and separately. Statistical variables for model variables cover 2000-2019. The evaluation of the models was performed in the statistical program Eviews. And our evaluation strategy is as follows : 1) Assessments will be conducted first, both nationally and in selected regions ; 2) The econometric explanation of the results will be given later ; 3) At the final stage, the economic interpretation of the results will be implemented.

Thus, the regression analysis of [15,19,22] using the least squares method was conducted as follows :

Total for the republic :

$$dln Y_t = 0.73 dln Y_{t-1} + 0.28 dln X_{1,t-1} + 5.58 dln X_{2,t-1} - 0.42 dln X_{3,t-1}$$

t-test : (0.03) (0.41) (0.04) (0.42)

$$R^2 = 0.71$$

F-test = 4.32 (probability=0.04)

Qaus-Markov terms ;

Heteroskedasticity

Breusch-Pagan-Godfrey testi

F-test = 0.83 (probability=0.54)

Xi square test = 3.88 (probability = 0.42)

Normality ;

JB test = 1.30 (probability = 0.52)

For Nakhchivan Autonomous Republic:

$$dln Y_t = -0.22 dln Y_{t-1} + 0.78 dln X_{1,t-1} - 2.33 dln X_{2,t-1} - 0.56 dln X_{3,t-1}$$

t-test : (0.63) (0.22) (0.76) (0.61)

$$R^2 = 0.21$$

F-test = 0.46 (probability=0.76)

For Baku city :

$$dln Y_t = 0.35 dln Y_{t-1} + 0.70 dln X_{1,t-1} + 8.30 dln X_{2,t-1} - 1.36 dln X_{3,t-1}$$

t-test : (0.28) (0.30) (0.06) (0.15)

$$R^2 = 0.61$$

F-test = 2.73 (probability=0.12)

Qaus-Markov terms ;

Heteroskedasticity

Breusch-Pagan-Godfrey test

F-test = 1.25 (probability=0.37)

Xi square test = 4.99 (probability = 0.29)

Normality ;

JB test = 1.24 (probability = 0.54)

For the economic region of Lankaran :

$$dln Y_t = -0.67 dln Y_{t-1} - 1.14 dln X_{1,t-1} + 19.1 dln X_{2,t-1} + 1.49 dln X_{3,t-1}$$

t-test : (0.15) (0.57) (0.37) (0.48)

$$R^2 = 0.36$$

F-test = 1.00 (probability=0.46)

For the economic region of Aran :

$$dln Y_t = -0.60 dln Y_{t-1} + 0.68 dln X_{1,t-1} + 16.9 dln X_{2,t-1} + 2.34 dln X_{3,t-1}$$

t-test : (0.17) (0.32) (0.03) (0.07)

$$R^2 = 0.76$$

F-test = 5.44 (probability=0.03)

Qaus-Markov terms ;

Heteroskedasticity

Breusch-Pagan-Godfrey test

F-test = 0.32 (probability=0.86)

Xi square test = 1.86 (probability = 0.76)

Normality ;

JB test = 2.10 (probability = 0.35)

For the economic region of Shaki-Zagatala :

$$dln Y_t = -0.27 dln Y_{t-1} + 1.78 dln X_{1,t-1} + 2.07 dln X_{2,t-1} + 1.04 dln X_{3,t-1}$$

t -test : (0.41) (0.03) (0.82) (0.53)

$$R^2 = 0.61$$

F-test = 2.73 (probability=0.12)

Qaus-Markov terms ;

Heteroskedasticity

Breusch-Pagan-Godfrey test

F-test = 1.13 (probability=0.41)

Xi square test = 4.69 (probability = 0.31)

Normality ;

JB test = 0.37 (probability = 0.82)

In the regression models, Y represents the investment in fixed assets, x_1 - the volume of industrial output , x_2 - the world market price of oil, x_3 - the volume of paid services , and t - the time.

5. Econometric and economic explanation of the models of regression evaluated for the Republic and its regions.

Apparently, the natural logarithmic estimates of all variables are taken into account in these models. Because there is no clear idea that the intended dependence is linear or nonlinear, and the assumption of variables in natural logarithmic expressions enables the linear representation of a nonlinear assumption model. On the other hand, the use of natural logarithmic expressions of variables allows the interpretation of the coefficients as a percentage, which helps to characterize the dependence of the dependent variable on the explanatory variables [13].

All regression equations used the values of the variables (t-1). It is assumed that changes in the volume of industrial output, world oil prices, and paid services will affect the change in capital investment after a period. Indeed, the rise in oil prices (t-1) and the impact on investment growth on t are more convincing. We can also make the same assumption for other variables. In addition, suppose that the investment in fixed assets in the t-period depends on its pre-existing values. However, the dependence of the fixed capital investment variable on its previous values was statistically significant only in the

model nationwide. Because in this model, the probability probability (0.03) of the fixed-capital investment variable itself is less than 0.05 (the numbers in brackets below the models). In all other models, the probability of the t-test for its fixed-term capital variable is greater than 0.05, which means that the previous value of the fixed-capital investment variable in the models evaluated for selected economic zones is statistically insignificant. The previous estimates of the change in industrial output (X_1) for the previous period were only statistically significant in the regression model estimated by the Sheki-Zagatala economic region (because the probability of the t test for this variable in the model is less than (0.03) 0.05). In other models, this variable is statistically insignificant. The effect of the change in the world market price of oil (X_2) on the capital investment variable was statistically significant in the regression models evaluated across the Republic, Baku, and Aran region (because the probability of t test was 0.04, 0.06, and 0.03, respectively). The effects of the global oil price (X_2) volatility on capital investment fluctuations are statistically insignificant in the regression models estimated for economic regions. The effect of the change in the volume of paid services (X_3) on the fixed capital investment (Y) was statistically insignificant in all models.

One of the key quantities in the regression analysis is the determination factor (R^2). This coefficient indicates how much of a change in a coefficient can be explained by changes in the explanatory variables. Thus, the established regression models show that 71% of the variation in the model depends on the republic, 21% in the Nakhchivan Autonomous Republic model, 61% in Baku model, and Lankaran economic model. 36%, 76% in the model of Aran economic region, and 61% in the Sheki-Zagatala economic region can be explained by changes in explanatory variables. It can be seen that the coefficient of determination is very small in the models of Nakhchivan and Lankaran economic regions. If we look, these models are inadequate. Thus, all of the explanatory variables in these models are statistically insignificant.

Another similar method that characterizes the adequacy of the model is the use of the F test result, which describes the joint

significance of the explanatory variables. The results of this test can be considered statistically significant in the models evaluated across the country and in the Aran economic region. Because in both models, the probability of the F-value is less than 0.05. In all the other models, the probability of the Quantity of F values is very high. Therefore, it is not worth mentioning the combined effects of explanatory variables in these models.

One of the main points when giving econometric explanations is related to the conditions of Gaus-Markov. Two main features are evident in meeting these conditions. The residuals of the first evaluated models should be homosceded, that is, the model should not have heteroskedasticity. Second, the model balances should have a normal distribution. The problem of heteroskedasticity of the models was investigated by the Breusch-Pagan-Godfrey test. As a result of the test, two quantities are calculated, the F value and the square Xi. Note that the Gauss-Markov conditions were not tested for models evaluated in the Lankaran and Nakhchivan economic regions. Because these models are already inadequate. All other models are subject to the Kaus-Markov terms. So, probability values of squares F and Xi calculated for both heteroskedasticity tests, as well as probability values of JB calculated for normality test, which is desirable.

The following are the main conclusions and recommendations generalized and substantiated by the author in the course of research :

1. The ways of creating a multi-sectoral economy in Azerbaijan have been described and the theoretical basis for diversification of production in the real economy has been developed. Mathematical and statistical analysis of the factors influencing the socio-economic system was conducted based on the principles of sustainable development of the Republic.

2. An optimal algorithm for determining the optimal investment in the sectors of the multi-sectoral economy has been developed and justified.

3. Differentiation of the quality criteria for the solution of the optimal investment problem in the multi-sectoral economy and the

necessary prerequisites for the solution of optimal management issues have been proved.

4. The problem of optimal investment in sectors of the economy has been proved to be the only solution.

5. In our view, the establishment and implementation of a well-grounded economic concept for the modernization of the public and private sector industrial base in the country should be considered as one of the most important tasks in the context of economic processes in Azerbaijan.

6. To achieve sustainable development of multi-sectoral production in public and private enterprises of the Republic, the following results were achieved :

- Modernization and improvement of structure of multi-sectoral economy in public and private enterprises ;
- Increasing the export potential of multi-sectoral production in public and private enterprises ;
- Expansion of multi-sectoral production of public and private enterprises of economy in scientific and innovative direction ;
- Training of qualified personnel for multi-sectoral production in public and private enterprises.

7. The economic essence of the State Programs in the socio-economic development of the regions of Azerbaijan was determined. Creation of manufacturing and processing processes, service infrastructure and multi-sectoral economy as a whole is noted as a result of economic reforms in the regions.

8. A regression model of interdependence between socio-economic indicators has been established based on the principles of sustainable development in the Republic and some of its regions.

9. The world market price for Brent oil is also included as an additional explanatory variable to enhance the adequacy of the evaluated models. The evaluation of the models was performed in the statistical program EvIEWS. The adequacy of the established models has also been verified.

10. The following results were obtained from analysis of the arranged model :

- In the model generally evaluated for the Republic, the

dependence of the current price of a fixed capital investment variable on its previous price and the world market price of oil is statistically reliable. As a result, a 1% rise in the cost of an investment in fixed assets increases the current price of this variable by 0.7%. A 1% rise in world oil prices for the previous period causes a 5.6% increase in the current price of fixed capital investment ;

- In the economic explanation of the coefficients of the estimated regression model for Baku, it should be noted that the formation of the present value of a change in the fixed capital investment for this economic region only has the economic value of changing world market prices for oil. Thus, it was found that a 1% rise in world oil price volatility over the period 2000-2019 increased the current cost of fixed capital investment by 8.30%. This elasticity indicator is much higher than the national elasticity index (5.58) ;

- Changes in the current value of the fixed capital investment variable in the Nakhchivan Autonomous Republic for the period 2000-2019 could not be explained by the volume of industrial output in these economic regions, the volume of paid services and the volatile world market oil prices. At the same time, previous prices for a fixed-capital investment variable have no economic value in forming its current value. ;

- Changes in the current amount of capital investment variables in the Lankaran economic region in 2000-2019 could not be explained by the volume of industrial output in these economic regions, the volume of paid services and the volatile world market price of oil. At the same time, previous prices for a fixed-capital investment variable have no economic value in forming its current value. ;

- From 2000 to 2019, it was found that of the variables taken in formation of fixed capital investment in Aran Economic Zone, only the world market price of oil and the variables of paid services for the economic region were of economic importance. A 1% rise in world oil prices and paid services volatility in the Aran economic region over the same period increased the current price of fixed capital investment by 16.9% and 2.34%, respectively ;

- According to the evaluation conducted for Shaki-Zagatala

economic region, it was found that, unlike other economic regions, only industrial output was economically significant in the formation of capital investments. As a result, an increase in industrial output by 1% over the same period of the previous year increased the current cost of the variable of fixed capital investment by 1.8%.

The main provisions of the dissertation, the results obtained and the conclusions are reflected in the following published articles and theses of the author:

1. Bağırova Ş.V. İnsan kapitalının inkişafı keyfiyyətli təhsilə əsaslanır / Dayanıqlı inkişaf və idarəetmə modelləri: nəzəriyyə və praktika beynəlxalq konfransın materialları. Lənkəran: 2011, s.131-132.

2. Bağırova Ş.V. Azərbaycanın Regionlarının bir sıra sosial-iqtisadi göstəricilərinin müqayisəli təhlili / Müasir elmin aktual problemləri ümummilli lider H.Əliyevin anadan olmasının 88-ci ildönümünə həsr olunmuş elmi konfrans materialları. Lənkəran: 2011, s.34-36.

3. Bağırova Ş.V. İqtisadi artımın dövlət tənzimlənməsində neoklassik model / Müasir elmin aktual problemləri ümummilli lider H.Əliyevin anadan olmasının 89-cu ildönümünə həsr olunmuş elmi konfrans materialları. Lənkəran: 2012, s.170-172.

4. Bağırova Ş.V. Azərbaycan Respublikasında iqtisadi artıma təsir edən əsas amillər və onların statistik təhlili // Azərbaycan Elmi – tədqiqat Kənd Təsərrüfatının İqtisadiyyatı və Təşkili İnstitutunun elmi əsərləri. III seriya, Bakı: 2012, s.33-37.

5. Bağırova Ş.V. Milli iqtisadiyyatın inkişaf modelinin formalaşması / Azərbaycan Respublikası Təhsil Nazirliyi Doktorantların və Gənc Tədqiqatçıların XVII Respublika Elmi Konfransının Materialları, II hissə. Bakı: 2012, s.207-208.

6. Bağırova Ş.V. İqtisadi – riyazi modelləşdirmə üsullarından istifadə etməklə bəzi sosial-iqtisadi göstəricilərin təhlili // Azərbaycan Milli Elmlər Akademiyası İqtisadiyyat İnstitutunun Elmi əsərləri. II buraxılış, Bakı: 2013, s.215-217.

7. Bağırova Ş.V., Əliyev Ə.Q. İKT sferasında iqtisadi artım modelləri vasitəsilə investisiyaların optimal idarə olunması / AMEA Riyaziyyat və Mexanika İnstitutunun 55 illiyinə həsr olunmuş Beynəlxalq konfransın materialları Riyaziyyat və mexanikanın aktual

problemləri. Bakı: 2015, s.90-92.

8. Bağırova Ş.V. Azərbaycanda investisiya qoyuluşlarının ümumi təhlili // Naxçıvan Dövlət Universitetinin Elmi əsərləri. İctimai elmlər seriyası, Naxçıvan: 2016, s.276-280.

9. Багирова Ш.В. Управление инвестициями в неоклассической многосекторной модели экономического роста / Актуальные вопросы развития социально-экономических систем в современном обществе материалы международной научно-практической конференции, часть 2. Саратов: 2013, с.155-158

10. Багирова Ш.В. Примененийе математических методов и моделей в экономике / Azərbaycan Memarlıq və İnşaat Universiteti İstilik energetika qurğularının tullantılarından ətraf mühitin mühafizəsinin mühəndis problemləri adlı beynəlxalq elmi konfransı. Bakı: 2016, s.251-254.

11. Искендеров А.Д., Багирова Ш.В. Оптимальное управление инвестициями в неоклассической многосекторной модели экономического роста // Lənkəran Dövlət Universitetinin Elmi Xəbərləri. Riyaziyyat və Təbiət Elmləri Seriyası, 2013, s.75-90.

12. Искендеров А.Д., Багирова Ш.В. Задача оптимального управления многосекторной модели экономического роста // В журнал Экономика и предпринимательство, М.: 2016, № 10(ч1), с.525-530.

13. Bağırova Ş.V. Ölkənin iqtisadi inkişaf dinamikasının sosial-iqtisadi göstəricilərə əsasən tədqiqi / Azərbaycan Respublikası Təhsil Nazirliyi Azərbaycan Memarlıq və İnşaat Universiteti. Elmi-praktik konfransın materialları. Bakı: 26 may 2017-ci il.

14. İsgəndərov A.D., Bagirova Sh.V. Multipurpose manufacturing process and management / XXXI International Conference Problems Of Decision Making Under Uncertainties (PDMU-2018).

15. Bağırova Ş.V. Respublikada iqtisadi artıma təsir edən əsas amillərin iqtisadi təhlili / Lənkəran Dövlət Universiteti “İnteqrasiya mühitində Azərbaycan elminin qarşısında duran vəzifələr” mövzusunda Respublika Elmi Konfransı. Dekabr 2018.

16. Bağırova Ş.V. Respublikada iqtisadi artım dinamikasını xarakterizə edən əsas amillərdən asılılığın ekonometrik model vasitəsi ilə təhlili / Azərbaycan Respublikası Təhsil Nazirliyi Azərbaycan

Memarlıq və İnşaat Universiteti “Azərbaycanda iqtisadi islahatların həyata keçirilməsinin aktual problemləri” mövzusunda Respublika Elmi-praktik Konfransın materialları. Bakı 2018.

17. Багирова Ш.В. Применение Математических Методов И Моделей В Экономике / Федеральное государственное бюджетное образовательное учреждение высшего образования «пензенский государственный технологический университет» Международная научно-практическая конференция «актуальные проблемы развития кооперации и Малого предпринимательства». 21 ноября 2018 года.

18. Bağırova Ş.V. İnnovasiyalar ilə məşğulluq arasında qarşılıqlı əlaqə / Azərbaycan Respublikası Təhsil Nazirliyi Sumqayıt Dövlət Universiteti “Azərbaycanın qeyri-neft sektorunun inkişaf perspektivləri” Respublika elmi konfransının materialları. Sumqayıt 2019.

19. Багирова Ш.В. Необходимость Многосекторального Производства В Государственных И Частных Предприятиях / «ІННОВАЦІЙНІ ТЕХНОЛОГІЙ ТА АКТУАЛЬНІ ПИТАННЯ ПІСЛЯЗБИРАЛЬНОЇ ДОРОБКИ ПЛОДООВОЧЕВОЇ ПРОДУКЦІЙ ЯК ВАЖЛІВ ПІДВИЩЕННЯ ЕКОНОМІЧНОЇ ЕФЕКТИВНОСТІ» Міністерство освіти і науки України ДВНЗ «Херсонський державний аграрний університет». 14-15 березня 2019 року

20. Bağırova Ş.V. Regionlarda sahibkarlıq subyektlərinin şaxələndirilmiş istehsal fəaliyyətinin əsas istiqamətləri / Azərbaycan Respublikası Təhsil Nazirliyi Lənkəran Dövlət Universiteti Elmi-praktik konfrans. Lənkəran, 7-8 may 2019

21. Bağırova Ş.V. Çoxsektorlu istehsalda optimal idarəetmə modeli / Azərbaycan Respublikası Təhsil Nazirliyi Bakı Dövlət Universiteti Tətbiqi riyaziyyat və kibernetika fakültəsi. Azərbaycan Xalq Cümhuriyyətinin 102-ci ildönümünə həsr olunmuş «Riyaziyyatın Tətbiqi Problemləri » Respublika virtual elmi konfransının materialları. Bakı, 3-4 iyun 2020-ci il.



The defense will be held *on “21” may 2021* at FD 1.11. Dissertation council of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at Azerbaijan State University of Economics.

Address: AZ 1001, Baku, Istiglaliyat street 6

The dissertation is accessible at the Azerbaijan State University of Economics Library.

Electron versions of dissertation and its abstract are available on the official website of the Azerbaijan State University of Economics.

Abstract was sent to the required addresses on *“21” april 2021*.

Signed for print: 20.04.2021
Paper format: 60x84 ¹/₁₆.
Volume: 20/04. Number of hard copies: 20
(34130 Symbols)

“AA – Polygraph” Production and Commercial Association
capevi@internet.ru Tel.: (+99455) 2012809