THE ECONOMETRIC STUDY OF DEPENDENCIES IN THE CONSTRUCTION SECTOR OF AZERBAIJAN

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Abstract

The study aims to identify the issues of a quantitative assessment of the dependencies between indicators in the residential buildings of the construction sector in the Republic of Azerbaijan. The main objective of the research is to build econometric models of the impact of household income, investment in fixed assets, and the number of marriages in the country on residential buildings being commissioned. The paper also analyzes the economic characteristics of the construction sector in the country and does point out that this sector is a complex economic and cybernetic system, where all operations by nature are random. The time series of indicators of the construction sector, which were tested for stationarity based on the "Dickey-Fuller" test, serving as the core information part of the chosen study. As a result of regression analysis, based on these time series, dual regression equations have been constructed that model the correlation dependence of housing being put into the operation on regressors. In the light of economic research, an initial multiple regression model of the construction sector was set up and its static characteristics were tested. Checking the multicollinearity of this model using the VIF matrix construction method clearly showed that the X2 regressor (investment in fixed assets) violates the model specification, therefore, it should be excluded from the regressors. Repeated econometric modeling without the X2 regressor made it possible to construct a new version of the regression equation, which in the course of model experiments was improved to a model meeting all the Gauss-Markov conditions, which is not only adequate to the real conditions of the housing and labor markets but also is suitable for forecasting. In the selected article, based on this econometric model, the prognostication of demand in the housing market until 2020 is carried out.

Keywords

Construction sector; time series; stationarity; Breusch-Godfrey test; Park test; multicollinearity; autocorrelation.

JEL Classification

B23, C01

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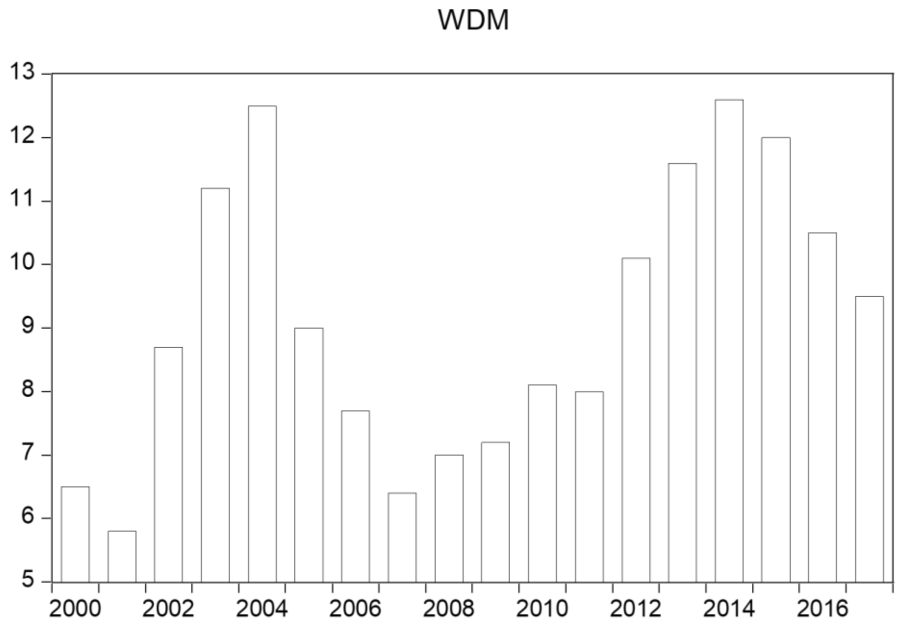
1 Introduction

Providing effective solutions to socio-economic development problems and ensuring a decent standard of living for the country's population are considered the fundamental priorities of the state's economic policy. Among the components of the vector of the socio-economic status and development of Azerbaijan, the labor market and the construction sector attract attention as components that directly affect the social status of the population. If the situation in the labor market is characterized by meeting the minimum needs of the population, providing them with housing becomes an indicator of their confidence in the future. The level of satisfaction of the country's population with the need for housing has a direct impact on population growth and social welfare within a society. In general, the state of the construction sector and the government's tendency to develop intensively in this sector can serve as a synthesized indicator of future economic development prospects and economic growth.

2 Economic characteristics of the construction sector

Among the components of the country's socio-economic situation and development vector, the labor market and the construction sector attract attention as main factors, which directly affect the social status of the population in the country. Thus, if the condition of the labor market is considered a pivotal feature of providing the population with minimal living conditions, their provision with housing becomes an indicator of their confidence in the future. The level of meeting the demand for housing in the country has a direct impact not only on population growth but also on social welfare in society. In general, the situation in the construction sector and the existence of an intensive development trend in this sector can play the role of a synthesized indicator of the country's economic environment and prospects for future economic development. The sustainable economic growth observed in Azerbaijan in recent years, the implementation of comprehensive and decisive measures aimed at reliably protecting the country's economy in the global financial crisis, and neutralizing the effects of this crisis have created favorable conditions for the development of the construction sector.

As a result, several important infrastructure projects have been launched in the country, the construction of social housing has begun, and the share of non-state enterprises in this sector has significantly increased. Consequently, within the last years, about 90% of construction work in our country is conducted by private enterprises and companies. The dynamic development observed in the construction sphere of the country has made it possible to reduce the tension caused by the financial crisis in the labor market, which is directly related to this sector, and to eliminate at least partially the disproportion between aggregate labor supply and demand. Therefore, a significant number of new jobs have been created in this sector, both in Baku and at the regional level. The share of value-added of the construction industry in the gross domestic product (GDP) (in a percentage) is shown in Graph 1.



Source: Ministry of Finance of the Republic of Azerbaijan, Available at www.maliyye.gov.az.

Graph 1 The share of value-added of the construction industry in GDP. (Shown in a percentage)

As can be seen from Graph 1 aforementioned, between 2005 and 2011, the share of value-added of the construction sector in GDP tended to decrease, however, in subsequent years there was an increase in this sphere. According to this, in 2014, this figure increased by 2 times compared to 2005 and exceeded 13%. If the construction sector is approached as a cybernetic system with complex interactions, it is possible to quantify and econometrically study the relationships between the variables by identifying the factors that directly affect the performance of this mentioned industry. [1]

3 Creation of dual regression models for the construction sector and assessing their adequacy

The econometric surveys of the country's construction sector were investigated in several stages according to the statistical database depicted in Table 1 given below.

Table 1 Statistical information on the construction sector of the economy

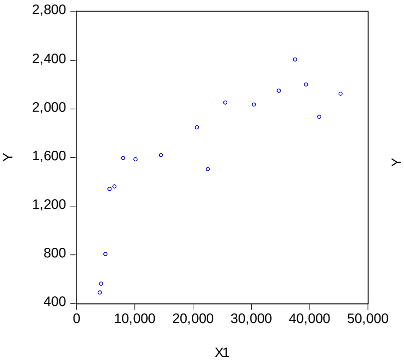
Year	Commissioning of residential buildings, a total area (thousand kV. m) Y	Population income (million manats) X_1	Investments in fixed assets from all financial sources (million manat) X_2	Number of marriages in the country X_3
2000	487	4047,3	967,8	39611
2001	560	4301,6	1170,8	41861
2002	803	5018,6	2107,0	41661
2003	1339	5738,1	3783,4	56091
2004	1359	6595,1	4922,8	62177
2005	1593	8063,6	5769,9	71643
2006	1583	10198,5	6234,5	79443
2007	1616	14558,2	7471,2	81758
2008	1845	20735,4	9994,4	79964
2009	1501	22601,1	7725,0	78072
2010	2049	25607,0	9905,7	79172
2011	2033	30524,6	12799,0	88145
2012	2147	34769,5	15402,3	79065
2013	2403	37562,0	17850,8	86852
2014	2197	39472,2	17618,6	84912
2015	1932	41744,8	15957,0	68773
2016	2121	45395,1	14903,4	66771
2017	2017,2	49162.9	15550,0	62923

Source: State Statistical Committee of the Republic of Azerbaijan, Available at www.stat.gov.az

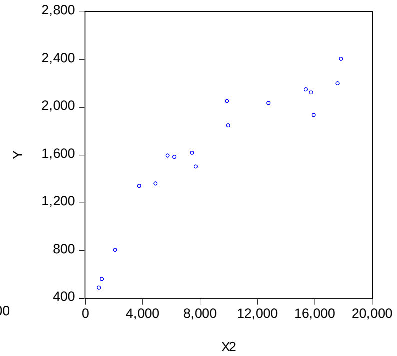
At the initial stage of the econometric survey on the quantitative assessment of dependencies in the construction sphere, an econometric analysis was conducted to mainly assess the quantitative relationship between the total area of housing commissioned in the country, and the population's income, capital investment from all sources, the number of marriages. [2] The key purpose of this phase is to calculate the relationship between the effect of regressors (explanatory variables) such as income (X1), fixed capital investment (X2) and the number of marriages (X3) on this indicator, taking into account the explained variables (Y) of the total area of residential buildings commissioned in the country. [3]

According to the study, before conducting a multivariate regression analysis on this problem, it is expedient to quantify the direct effect of each of the regressors X_1, X_2, X_3 on the Y result. Graph 2 mainly illustrates the correlation between the total area of housing hired in the country and the income of the population (a), the volume of investment in fixed assets (b), and the number of marriages in the country (c).

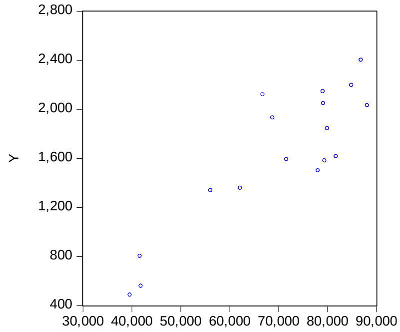
Graph 2 Depiction of correlation between the total area of residential buildings commissioned in the country and the income of the population (a), the volume of investment in fixed assets (b), and the number of marriages in the country (c). [4]



(a)



(b)



(c)

Visual analysis of these graphs shows that at the specification stage of econometric modeling, it is advisable to identify the dependencies as linear and use the linear regression models of $y_i=b_0+b_1x+e_i$ to express them. [5,6] The following regression equations were obtained as a result of regression analysis performed based on the Eviews program.

Table 2 Regression analysis according to the Eviews program

Purpose of econometric analysis	The mathematical expression of the regression equation	Statistical significance of coefficients	Determination and correlation coefficient
Econometric analysis of the dependence of the total area of commissioned housing on the income of the population	$Y=943{,}966+0{,}03227\ X_1$	$P_0=0{,}00$ $P_1=0{,}00$	$R^2=0{,}71$ $r=0{,}84$
Econometric analysis of the dependence of the total area of commissioned housing on the volume of investments in fixed assets	$Y=797{,}665+0{,}09010\ X_2$	$P_0=0{,}00$ $P_1=0{,}00$	$R^2=0{,}86$ $r=0{,}93$
Econometric analysis of the dependence of hired residential buildings on the number of marriages in the country	$Y=551{,}320+0{,}03114\ X_3$	$P_0=0{,}00$ $P_1=0{,}09$	$R^2=0{,}78$ $r=0{,}88$

One of the important tasks of econometric modeling is to scrutinize the existence of interactions between economic indicators being studied. The simplest mechanism used for this purpose is a correlation coefficient that reflects the relative strength of the links and value varies in the range of $-1 \leq r_{xy} \leq +1$. The $r_{yx_1} = 0{,}84; r_{yx_2} = 0{,}93; r_{yx_3} = 0{,}88$ values obtained in the research process depict that there is a fairly close positive correlation between the Y- dependent variable and the regressions of X_1, X_2, and X_3. [7]

4 Building multiple regression models in the construction sector and assessing their adequacy

In the second stage of the study, an econometric analysis of the dependence of the total area of commissioned residences in the country on X_1, X_2, and X_3 regressors was conducted. The results of solving the problem based on the Eviews program were as follows below. [8]

Table 3 VIF Matrix building

Dependent Variable: Y
Method: Least Squares
Date: 09/15/18 Time: 21:31
Sample: 1 18
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	27.41559	207.2680	0.132271	0.8968
X_1	-0.006544	0.011505	-0.568783	0.5792
X_2	0.076276	0.033769	2.258741	0.0417
X_3	0.014824	0.003967	3.736361	0.0025

R-squared	0.942589	Mean dependent var	1621.647
Adjusted R-squared	0.929340	S.D. dependent var	570.9321
S.E. of regression	151.7650	Akaike info criterion	13.08487
Sum squared resid	299423.9	Schwarz criterion	13.28092
Log-likelihood	-107.2214	Hannan-Quinn criteria.	13.10436
F-statistic	71.14541	Durbin-Watson stat	1.738832
Prob(F-statistic)	0.000000		

According to these statistics;

b_0=27,41559; b_1=-0,006544; b_2=0,076276; b_3=0,014824 the following regression equation is obtained:

$$Y=27,41559-0,006544X_1 + 0,076276X_2 + 0,014824X_3 \quad (1)$$

P (0,90) (0,58) (0,04) (0,00)

According to the received econometric model, changes in the income of the population do not affect the total area of commissioned housing in the country. Thus, shifts in incomes have a mitigating effect on changes in housing areas with some delay. More precisely, the increase in income by one million manats will lead to a decrease in the total area of hired apartments by 0.0065 thousand kV meters. The growth of other regressors has a positive impact on the areas of residences. Thus, the increase in fixed assets of investment by one million manats will increase the area of apartments by 0.076 thousand kV meters, and a single increase in the number of marriages led to an increase in the area of apartments by 0.015 thousand kV meters. Note that (1) this economic interpretation is taken as a preliminary decision because the quality of the regression model has not been tested.

Comparing the values of the "P" probabilities of the coefficients of the model (1) with the "α" reliability level shows that the "b1" coefficient of the variable X1 is statistically insignificant meaning that the model is not properly specified. One of the reasons for this may be that the known conditions of the "Gauss-Markov" theorem are not fully expected in the evaluation of coefficients. [9,10] Therefore, for the model (1) it is necessary to check out whether there is a serious linear dependence between the explanatory variables, or rather the existence of multicollinearity. The most widely used method for checking the multicollinearity of a model is the method of constructing the VIF matrix. (1) The results of the computer modeling of the VIF matrix for the regression model are presented in the following table. [4,10]

Table 4 VIF Matrix building

Variance Inflation Factors
Date: 09/15/18 Time: 21:25
Sample: 1 18
Included observations: 18

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	42960.03	31.70812	NA
X_1	0.000132	63.36887	2.30178
X_2	0.001140	97.26353	26.88311
X_3	1.57E-05	59.39750	2.856857

As can be seen from the table, the value of VIF is greater than 5 for the X_2 variable alone, which is linearly dependent on any of the other explanatory variables and violates the specification of the model. [11] Therefore, it is necessary to exclude the X_2 variable from the chosen study. An econometric analysis for this variant found no multicollinearity. The results of the econometric modeling for the new composition of the explanatory variables (income of the population - X_1; the number of marriages in the country X_3) are presented in the following table.

Table 5 VIF Matric building

Dependent Variable: Y
Method: Least Squares
Date: 09/18/18 Time: 23:15
Sample: 1 18
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-211.7921	202.5970	-1.045386	0.3136
X_1	0.018392	0.003683	4.993605	0.0002
X_3	0.020746	0.003386	6.127448	0.0000
R-squared	0.920057	Mean dependent var		1621.647
Adjusted R-squared	0.908637	S.D. dependent var		570.9321
S.E. of regression	172.5718	Akaike info criterion		13.29829
Sum squared resid	416934.2	Schwarz criterion		13.44533
Log-likelihood	-110.0355	Hannan-Quinn criter.		13.31290
F-statistic	80.56277	Durbin-Watson stat		1.771052
Prob(F-statistic)	0.000000			

According to this table, the following regression equation is obtained for the dependence of the total area of housing commissioned in the country (Y) on the X_1 and X_3 explanatory variables.

$$Y = -211{,}7921 + 0{,}018392X_1 + 0{,}020746X_3 \qquad (2)$$

$$P \ (0{,}31) \quad (0{,}00) \quad (0{,}00)$$

(2) The "P" probabilities of the coefficients of the regression equation revealed that both the b_1 and b_3 coefficients are statistically significant, only the free variable is not statistically important. [10,12] Under this equation, as a result of an increase in the income of the country's population by one million manats, the total area of residential apartments commissioned averagely increases 0.018392 thousand kV meters. A single increase in the number of marriages will increase the total area of housing by about 0.020746 thousand kV meters. The study of regression statistics from model experiments ostensibly shows that the value of the determination coefficient and multi-correlation coefficient was R^2 = 0,92 and R = 0,96 respectively. Thus, there is a fairly linear relationship between the "Y" indicator and the X_1 and X_3 explanatory variables and the model adequately reflects the change in the area of residential buildings commissioned across the country. [13]

Based on the general approach, one of the mechanisms violating the clarity of econometric studies and the level of accuracy of the results obtained is the detection of autocorrelation between the residuals of the model. In this regard, the "rough rule" approach, one of the core mechanisms of the "Darbin-Watson" statistic realization, was used to test the H0 hypothesis of autocorrelation in the above econometric model variant, and as a result, 1.5 <DW = 1.77 <2.5 was found for this econometric model. [1,2] Hence, the hypothesis that there is no autocorrelation for the model in question can be considered true. The logarithm of the given time series is obtained here to improve the quality of Model (2).

Table 6 VIF Matric building

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 11/09/18 Time: 20:03
Sample: 2000 2017
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.466941	2.027581	-3.189485	0.0061
LOG(X1)	0.222869	0.063068	3.533773	0.0030
LOG(X3)	1.045792	0.218103	4.794955	0.0002

R-squared	0.893317	Mean dependent var	7.322776
Adjusted R-squared	0.879093	S.D. dependent var	0.464032
S.E. of regression	0.161352	Akaike info criterion	-0.659444
Sum squared resid	0.390517	Schwarz criterion	-0.511049
Log-likelihood	8.934998	Hannan-Quinn criter.	-0.638982
F-statistic	62.80181	Durbin-Watson stat	0.978310
Prob(F-statistic)	0.000000		

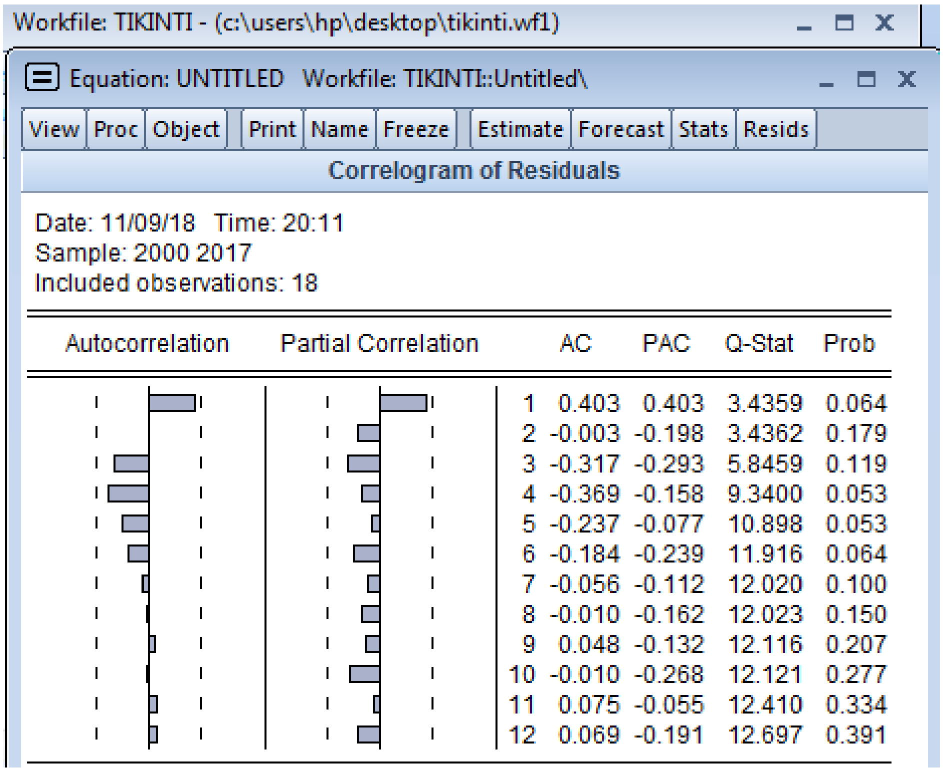
According to this table, the following regression equation is obtained for the dependence of the total area of commissioned apartments in the country on the log of the explanatory variables (Y), log (X_1), and log (X_3). (3) The "P" probabilities of the coefficients of the regression equation show that both the free limit and b_1 - and b_3 coefficients are statistically significant. [14]

$$\mathrm{Ln(Y)} = -6{,}4669 + 0{,}2229\mathrm{Ln}(\mathrm{X}_1) + 1{,}0458\mathrm{Ln}(\mathrm{X}_3) \qquad (3)$$

$$P \ (0{,}00) \quad (0{,}00) \quad (0{,}00)$$

Based on this equation, as a result of an increase in the income of the country's population by one million manats, an average of 0.2229 thousand kV meters increases in the total area of residential buildings in the country. The growth in the number of marriages will lead to an increase in the area of housing by 1.0458 thousand kV meters. The investigation of regression statistics from model experiments illustrates that the value of the determination and multi-correlation coefficient was R^2 = 0,89, and R = 0,87 separately. In this matter, there is a fairly linear dependency between the "Y" indicator and the X_1 and X_3, explanatory variables, and the model adequately reflects the change in the area of residences in the country. [15,16]

Since the model parameters are logarithmic, the autocorrelation function (residual correlation) can also be used to determine whether there is an autocorrelation or not. In this case, the main difficulty is to identify the number of lags used in the test. If the number of lags is considered small, the test may not detect autocorrelation in large ones. We approach the lag as the compilation of the autocorrelation coefficient, to a large extent, the number of cycles in which the coefficient is calculated. For example, if the lag is equal to a unit, then the first-order autocorrelation coefficient, which measures the relationship between the residuals will be calculated. [2]



	AC	PAC	Q-Stat	Prob
1	0.403	0.403	3.4359	0.064
2	-0.003	-0.198	3.4362	0.179
3	-0.317	-0.293	5.8459	0.119
4	-0.369	-0.158	9.3400	0.053
5	-0.237	-0.077	10.898	0.053
6	-0.184	-0.239	11.916	0.064
7	-0.056	-0.112	12.020	0.100
8	-0.010	-0.162	12.023	0.150
9	0.048	-0.132	12.116	0.207
10	-0.010	-0.268	12.121	0.277
11	0.075	-0.055	12.410	0.334
12	0.069	-0.191	12.697	0.391

Graph 3 Autocorrelation coefficient measuring the relationship between the residuals

The correlogram of the residuals aforementioned depicts that the value of each of the lags is within the limits of reliability. So, indeed, the model does not have any order of autocorrelation. For this model, the existence of serial autocorrelation was tested based on the "Breuch-Godfrey" test shown in Table 7 and the following statistics were obtained.

Table 7 "Breusch-Godfrey" Serial Correlation LM Test

F-statistic	1.725196	Prob. F(2,13)	0.2165
Obs*R-squared	3.775415	Prob. Chi-Square(2)	0.1514

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 11/09/18 Time: 20:14
Sample: 2000 2017
Included observations: 18
Pre sample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.868047	2.119104	0.409629	0.6887
LOG(X1)	0.022438	0.065266	0.343786	0.7365
LOG(X3)	-0.097548	0.230631	-0.422961	0.6792
RESID(-1)	0.519375	0.279616	1.857462	0.0860
RESID(-2)	-0.162873	0.290703	-0.560272	0.5848

R-squared	0.209745	Mean dependent var	-1.29E-15
Adjusted R-squared	-0.033410	S.D. dependent var	0.151564
S.E. of regression	0.154075	Akaike info criterion	-0.672622
Sum squared resid	0.308608	Schwarz criterion	-0.425296
Log-likelihood	11.05360	Hannan-Quinn criter.	-0.638519
F-statistic	0.862598	Durbin-Watson stat	1.879358
Prob(F-statistic)	0.511697		

According to this statistical report, since the Prob (F-statistic) = 0.2165> α = 0.05, the hypothesis of not having autocorrelation in the model is confirmed. [17] To compare the quality of the regression models (2) and (3) of the total area of dwellings, their quantitative characteristics need to be obtained. For this purpose, the following criteria will be used. [11,13]

- t - values of statistics
- Price of R^2 and normalized R^2
- Information criteria

Amemya (AM)

$$AF = RSS \cdot \frac{n+m}{n-m} \rightarrow \min$$

Here "m" is the number of coefficients

Akayke (AIC)

$$AIC \rightarrow \min$$

Shvarts (SIC)

$$SIC \rightarrow \min$$

Thus, the lower the value of the criteria included in group 3, the higher the quality and usefulness of the model. [18] The following Table 8 shows the results of the assessment of the quality of the regression models (2) and (3) of the total area of residential houses in the construction sector of Azerbaijan based on these criteria.

Table 8 Assessment of the quality of the regression models (2) and (3) of the total area of apartments commissioned in the construction sector of Azerbaijan

Selection criteria	Set of variables of the model (2)	Set of variables of the model (3)	Note
	X_1 X_3	$Log(X_1)$ $Log(X_3)$	
P (t-statistics)	0.0000 0.0000	0.0000 0.0000	The significance of both models is good.
R^2	0,92	0,89	High in the model (2)
Normalized R^2	0,91	0,87	High in the model (2)
AF	521478,25	0,4875	Low in the model (3)
AIC	13,22	-0,659	Lower in the model (3)
SIC	13,37	-0,511	Low in the model (3)

Thus, the use of the model (3) in the analysis and prognostication of the total area of residences in the construction sector of Azerbaijan is more favorable than the model (2) in many respects, which is considered more adequate to real conditions and has good predictive qualities. Therefore, it is suitable to perform the future econometric analysis on the model (3). The studies show that one of the problems in econometric modeling is the problem of heteroscedasticity as one of the "Gauss-Markov" conditions violates the condition of stability of variances of random deviations. [19,20] Thus, this problem can lead to the ineffectiveness of the values set by the ECM for the parameters of the regression equation, or rather, to the fact that the insignificant values are mistakenly considered statistically significant. In this research, "White and Park's" tests were conducted to test whether the (3) regression model reflecting the dependence of housing across the country on income and the number of marriages, is heteroskedastic or not. Thus, the statistics for testing the model (3) with the White test are shown in the following table.

Table 9 Heteroskedasticity Test: White Test

F-statistic	2.809585	Prob. F(5,12)	0.0662
Obs*R-squared	9.707592	Prob. Chi-Square(5)	0.0840
Scaled explained SS	4.833650	Prob. Chi-Square(5)	0.4365

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 11/09/18 Time: 20:22
Sample: 2000 2017
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-36.14445	22.28899	-1.621628	0.1308
LOG(X_1)	-1.423816	0.906323	-1.570980	0.1422
(LOG(X_1))^2	-0.000422	0.027053	-0.015603	0.9878
(LOG(X_1))*(LOG(X_3))	0.127425	0.091456	1.393289	0.1888
LOG(X_3)	7.798583	4.652446	1.676233	0.1195
(LOG(X_3))^2	-0.407927	0.246283	-1.656336	0.1235

R-squared	0.539311	Mean dependent var	0.021695
Adjusted R-squared	0.347357	S.D. dependent var	0.026734
S.E. of regression	0.021597	Akaike info criterion	-4.571313
Sum squared resid	0.005597	Schwarz criterion	-4.274522
Log-likelihood	47.14182	Hannan-Quinn criter.	-4.530390
F-statistic	2.809585	Durbin-Watson stat	2.715146
Prob(F-statistic)	0.066200		

According to the White test, if the $H_0\colon Wh = n \cdot R_{Wh}^2 < \chi^2(m_{Wh})\ the$ hypothesis is satisfied, then the model has a homoskedastic feature, and if the $H_1\colon Wh = n \cdot R_{Wh}^2 \geq \chi^2(m_{Wh})$ the hypothesis is satisfied, there is heteroskedasticity. [4,20,21] Regarding abovementioned statistics of the White test (3), there is no homoscedasticity in the econometric model because of $R^2 = 0{,}539311\ Wh = n \cdot R_{Wh}^2 = 18 \cdot 0{,}54 = 9{,}72 < 11{,}07 = \chi_{0{,}05}^2(5)$ Based on the White test mentioned above (3), the condition of homoscedasticity does not exist as it is in the econometric model. Another test for testing homoskedasticity in a model is the Park test. [4]

$$lne^2 = \gamma_0 + \gamma_1 lnx_1 + u_t$$
$$lne^2 = \gamma_0 + \gamma_1 lnx_3 + u_t$$

The u_t residuals in the model should have to be both homoskedastic and have a normal distribution.

$$H_0\colon \left[t_{müş}(Lnx)\right] < t_{krit}\ və\ ya\ (P > \alpha)\ \ homoskedastic$$
$$H_1\colon \left[t_{müş}(Lnx)\right] \geq t_{krit}\ və\ ya\ (P \leq \alpha)\ \ \text{heteroskedastic}$$

The Park test is applied to verify this condition on the econometric model (3). The statistics of testing using the Park model for the X_1 explanatory variable (population income) are shown in the table below. [22,23]

Table 10 Park Test

Dependent Variable: LOG(E)
Method: Least Squares
Date: 09/11/18 Time: 20:28
Sample: 1 18
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.79481	4.083080	3.378530	0.0041
LOG(X1)	-0.458021	0.422023	-1.085298	0.2949
R-squared	0.072808	Mean dependent var		9.380782
Adjusted R-squared	0.010995	S.D. dependent var		1.495780
S.E. of regression	1.487534	Akaike info criterion		3.742248
Sum squared resid	33.19137	Schwarz criterion		3.840273
Log-likelihood	-29.80911	Hannan-Quinn criter.		3.751992
F-statistic	1.177871	Durbin-Watson stat		2.744746
Prob(F-statistic)	0.294925			

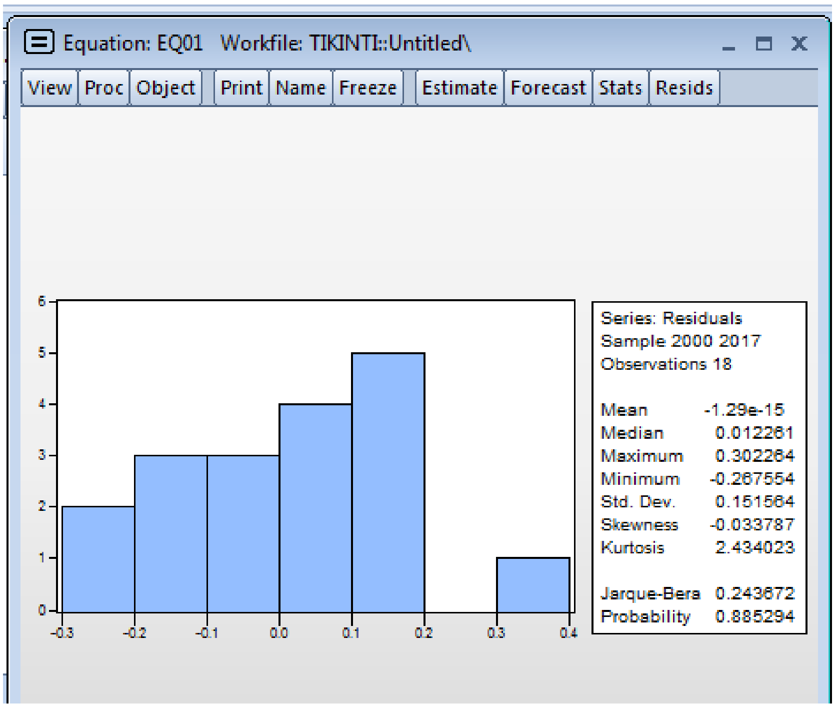
Under these statistics, $P = 0{,}29 \geq 0{,}05 = \alpha$ is obtained and for the model (3) no heteroskedasticity is observed for the X_1 explanatory variable. [24] (3) On the X_3 explanatory variable of the econometric model, the Park test gives the following result below.

Table 11 Park Test

Dependent Variable: LOG(E^2)
Method: Least Squares
Date: 09/22/18 Time: 16:20
Sample: 1 18
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.79781	15.71093	1.451080	0.1673
LOG(X_3)	-1.206310	1.412169	-0.854225	0.4064
R-squared	0.046390	Mean dependent var		9.380782
Adjusted R-squared	-0.017184	S.D. dependent var		1.495780
S.E. of regression	1.508577	Akaike info criterion		3.770342
Sum squared resid	34.13706	Schwarz criterion		3.868367
Log-likelihood	-30.04790	Hannan-Quinn criter.		3.780085
F-statistic	0.729700	Durbin-Watson stat		2.768740
Prob(F-statistic)	0.406417			

To these statistics, $P = 0{,}41 \geq 0{,}05 = \alpha$ is obtained and for the model (2) no heteroskedasticity is observed for the X_3 variable. [17,25] Amid the study, to evaluate the distribution law of the residuals of model (3) “Jarque Bera” test was applied. The statistics of the test are as followed.



Graph 4 Dispersion theory of the residuals of model (3) based on "Jarque Bera" test

The analysis of these statistics of the "Jaka-Berra" test shows that these residuals are subject to the law of normal distribution because the residuals of the model have a mathematical expectation of (Mean = 4,10e-15≈0) və P(Jarque-Bera)=0.8852 > α=0.05. [14,26,27] Thus, the econometric model (3), reflecting the dependence of housing (Y) on the income of the population (X1) and the number of marriages (X3), is a well-defined model, protected from autocorrelation and heteroskedasticity. This model is quite adequate to the real situation and can be used successfully to forecast the population's demand for housing.

5 Conclusions

The construction sector has all the characteristics of economic and cybernetic systems considered complex, dynamic and stochastic systems. As a result, this sphere of the economy is the object of mathematical modeling that ensures the optimization of management decisions. It is an undeniable fact that the studies of the construction sector based on econometric modeling have revealed that the key result of the residential building segment is directly influenced by such important factors including the income of the population, investment in fixed assets, and the number of marriages in the country. However, the conducted econometric analyses based on the method of variation of the dispersion - inflationary factor have shown that the factor of investments in fixed assets violates the specifics of the model and should be excluded from the regression analysis. The econometric study carried out for the new composition of the explanatory variables also observed that all the Gauss - Markov conditions are satisfied for the obtained regression equations, which are not multicollinear, homoscedastic, and there is no autocorrelation of residuals. Consequently, the proposed econometric models adequately reflect the real situation in the construction sector and can be successfully used to predict the demand for housing. With the abovementioned econometric investigation based on the models obtained, it was revealed that the forecast error is estimated at 1.67%, which indicates a good quality of the model.

References

[1] Borodich, S.A. (2006). Econometrics (3rd ed.)., Minsk: Minsk New Knowledge LLC.

[2] Chitaya, G.O., Miksyuk S.F., and et.al (2018). Econometrics and Economic - Mathematical Methods and Models, Minsk: Belarusian State Economic University.

[3] Melnikov, R.M. (2014). Econometrics: textbook. Moscow: Prospect.

[4] Vasenkova, E.I., Abakumova, Y.G., Bokova, S.Y. (2015). Workshop on econometrics: Textbook. A method, Minsk: Belarusian State University.

[5] Harrington, E. (1965). The Desirable Function. Industrial Quality Control. 21. (10.), pp. 494-498.

[6] Hajizalov, Y.I., Karimova, Y.R., Huseynova, L.N. (2013). Econometrics. (3rd ed.). Baku: Azerbaijan State University of Economics.

[7] Bobkov, V.N., Herremsen, P., et. al (2018). Two-criterion model of string verification of Russian society by income and housing. The economy of Region, 4, 1061-10745.

[8] Dougherty, C. (2011). Introduction to Econometrics (4 th ed.). Oxford University Press. pp. 512.

[9] Verbik, M. A. (2008). Guide to Modern Econometrics., pp.616.

[10] Eliseeva, I.I., Kurysheva, S.V., Kosteeva, T.V. (2007). Finance and Statistics.

[11] Huseynova L.N. (2016). Issues of econometric analysis of the labor market of Azerbaijan. Journal of Economics and Entrepreneurship, Moscow, pp. 530-536.

[12] Emelyanov, A.A., Vlasova, E.A., Duma, R.V. (2002). Simulation of economic processes. M.: "Finance and Statistics.

[13] Huseynova, L.N. (2018). Analysis and forecasting of the labor market based on econometric methods: author. dis. cand. econ. Sciences: 5302.01.

[14] Doronina, A.I. (2016). Time Series Models: AR (P), MA (Q), ARIMA (P, D, Q). An example of a study of the consumption of petroleum products in France. M .: Financial University under the Government of the Russian Federation.

[15] Nosko, V.P. (2011). Econometrics.

[16] Pelikh, A.S., Terekhov, L.L., Terekhova, L.A. (2005). Economic - mathematical methods and models in management. Moscow.

[17] Publishing house SPbGUEF. (2009). Guidelines for the implementation of laboratory work on econometrics. (computer workshop in Excel and EViews). SPb, 22.

[18] Magnus, Y.R., Katyshev, P.K., Peresetskiy, A.A. (2004). Econometrics. Initial course: Textbook. (6th ed.).

[19] Poole, W. (1968). Commercial bank reserve management in a stochastic model: implications for monetary policy. Journal of Finance. pp. 769- 791.

[20] Khatskevich, G.A. Gedronovich, A.B. (2007). Econometrics: textbook.-method. complex. Minsk.

[21] Gujarati, D.N., Porter, D. (2009). Essentials of Econometrics. (4th ed.). McGraw-Hill Irwin.

[22] Stock, J.H., Watson, M.W. (2010). Introduction to Econometrics. (3rd ed.). Addison-Wesley.

[23] Nash, J. (1950). The bargaining problem. Econometrica, pp.156-162.

[24] Buravlev, A. (2019). Econometrics: a training manual. M.: BINOM. Laboratory of Knowledge.

[25] Studenmund, A.H. (2010). Using Econometrics: A Practical Guide. (6th ed.). Addison-Wesley.

[26] Sevruktekin Mustafa. (2014). Introduction to Econometrics, Dora broadcasts.

[27] Tekin Mustafa & Çaghlayan Ebru. (2003). Basic Econometrics with Excel. Der broadcasts.