The impact of economic growth and fiscal policy on poverty rate in Uzbekistan: application of neutrosophic theory and time series approaches

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Abstract

The aim of this paper is to analyze how economic growth and fiscal policy impact on poverty rate in Uzbekistan. To reach this aim neutrosophic-AHP method was applied together with two time series models, namely Autoregressive Distributed Lags (ARDL) and Vector Autoregression (VAR) models. The statistical data of Uzbekistan over the period of 2000-2021 was used. Neutrosophic-AHP served as a basis for time series analysis. In accordance with AIC and BIC criteria, VAR was chosen as the most adequate model. Results of VAR model showed that a poverty rate has a delay effect on two years, when the increase of the second lag of poverty difference by one unit also increased current poverty difference by 0.501 units. Also, it was revealed that economic growth affects poverty adversely with delay in one lag, whereas taxes – with two lags. Interesting situation occurred with government expenditures, which impacted negatively on poverty after a one-year lag, but positively after two lags.

Keywords: poverty; economic growth; fiscal policy; neutrosophy, ARDL; VAR

1. Introduction

Poverty is a big socio-economic problem all over the world. According to estimations of the United Nations, 657-676 million people are living in extreme poverty in 2022 [1], whereas almost the half of the world population (over 3 billion people) are living below the poverty line of US$6.85 per day (the average of the national poverty lines of upper-middle-income countries) [2]. These are big numbers, thus, to combat with this issue, the United Nations put forward Sustainable Development Goals, in which as the first goal it stated eradicating poverty in all its forms [3].

Based on this world programme, the governments of different countries are developing their own strategies on reducing poverty level and maintaining sustainable development of their countries. And Uzbekistan is not an exception. In line with these Sustainable Development Goals, on February 21, 2022, Resolution No. 83 of the Cabinet of Ministers of the Republic of Uzbekistan "On additional measures to accelerate the implementation of national goals and objectives in the field of sustainable development in the period up to 2030" was adopted, according to which national goals and tasks in the field of sustainable development were determined in the period up to 2030. The first of the national goals is the reduction of the poverty level. To fulfill this goal, the implementation of the following tasks has been promoted until 2030:

– to halve the poverty rate in Uzbekistan;
– to halve the proportion of poor men, women and children of all ages in all forms of poverty;
– to strengthen the addressability and effectiveness of the social protection system, improve the quality of social protection services, and achieve the full coverage of population who need social protection measures;
– to improve the living conditions of poor people and protect them from the negative consequences of economic, social and ecological problems;
– to provide convenient economical and financial support, including microfinancing, to poor people to give them an opportunity to use their own resources effectively [4].

However, it should be mentioned that the big interest in the poverty issue in Uzbekistan appeared only from the 2020 after the speech of the President of Uzbekistan when he officially announced the share of population living in poverty [5]. Although at the end of 90-s of the 20th century and beginning of 21st century scholars were conducting research on poverty in Uzbekistan, unfortunately, after 2010s this topic was not opened to 2020. Because of this almost a decade gap, the poverty research are important in Uzbekistan case. This paper is an attempt to fill this gap by analyzing the impact of economic growth and fiscal policy elements on poverty rate of Uzbekistan.

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Furthermore, it should be highlighted that poverty is a social issue and one of the attributes of social sciences is the uncertainty. [6] introduced uncertainty, having non- probabilistic character, into mathematical modeling through developing theory of fuzzy sets. [7] improved and generalized this theory through developing intuitionistic fuzzy sets. Further, [8] developed a new neutrosophic logic and sets theory. Neutrosophy can be explained as a knowledge of neutral thought, which became the main differentiation of this new theory from previous fuzzy set theories [9]. Also, time series analysis was conducted by creating ARDL and VAR models to analyze the relationship between variables. Finally, to investigate the causality between variables, Granger causality test was conducted. To our knowledge this is the first research analyzing poverty from these viewpoints in Uzbekistan case.

The rest of this paper is structured as follows: Section 2 explores the previously conducted poverty investigations. Section 3 describes the used data and followed methodology. Section 4 illustrates and discusses the obtained results. Section 5 includes concluding remarks and provides with a big picture on the relationship between poverty, economic growth and fiscal policy.

2. Literature Review

Poverty is a debatable issue among scholars as there is no consensus on how to define or measure it [10-12]. That is why there are different approaches on poverty measurement, all of which can be categorized into three groups. The first and most widespread approach in poverty measurement is a monetary approach when the person is considered as poor when they do not have enough money to maintain their livelihood [13]. In other words, poverty is measured by money: how much they earn or spend. In many countries as well as international organizations the poverty is measured using monetary approach [14]. Yet, many researchers put under question the basis of this approach, whether poverty is only money issue, and they put forward their approaches, which formed the second group of approaches to poverty. They claimed that poverty is a lack of opportunities, education, healthcare and so on [15-17]. The third group of researchers rely on anthropometric measurements as the weight, height and energy consumption when measuring the poverty, claiming that the lower these indicators of the normal status, the individuals are malnourishing, hence they are poor [18-20]. The government of Uzbekistan in poverty measurement held the third approach to poverty, when the poverty line was established on the level of 2,100 kilocalories per day. It should be mentioned, that until 2020 the government did not recognize the existence of poor people, calling them just as people with low-income. It is interesting that although the government in measuring poverty used a food-energy intake method, in classifying people it supported monetary approach.

There are different factors affecting poverty, where the main interest is economic growth factor. There are different views on the relationship of economic growth and poverty. According to [21-22] economic growth automatically reduces the poverty rate via "spilling over onto" the poor, whereas [23-24] claimed that it is not an automatically process. [25] in case of Mexico and [26] in case of South Africa showed that economic growth reduces poverty. [27] illustrated that the economic growth decreases multidimensional poverty via using panel data of 91 countries. [28] applying Autoregressive Distributed Lag (ARDL) method revealed that there is an inverse relationship between economic growth and poverty rate in Malaysia, whereas the same result was obtained in the USA case by using a VECM model [29]. However, [30] found no causal relationship between these variables in Swaziland case. [31] investigated the relationship between poverty rate, financial development and unemployment rate in Uzbekistan and found that financial development did not impact on poverty rate, yet an increase in poverty rate decreased unemployment rate.

According to [32] economic growth leads to poverty reduction, yet only this is not enough. Fiscal policy also play important role in poverty alleviation, and it is important to evaluate equally the effects of both government revenues and expenditures when the impact of fiscal policy is analyzed [33]. Thus, apart from economic growth in this paper also two main variables of fiscal policy are analyzed: revenues and expenditures of the governmental budget. In Iranian case it was illustrated that the poverty-head-count-ratio and inequality are decreased by fiscal system, where taxes were special effective in increasing revenue without increasing poverty [34]. [35-36] found that government expenditures are important in poverty reduction, so in Turkey case the Autoregressive Distributed Lag (ARDL) model was constructed which showed that inequality and poverty are reduced by increasing government expenditures [35]. [37] revealed that an increase in social expenditures reduces the risk of joint-income-wealth-poverty. Yet, in Indonesian case fiscal policy had insignificant results in poverty reduction [38]. As regards tax system, it is relatively prone to changes, and according to [39] tax structure reforms in Latin American countries impacted the poor efficiently, whereas from the results of [40] it was revealed that the increase in indirect taxes also increased poverty rate in Pakistan. There is an interesting case in Tunisia, where the extreme poverty is affected by fiscal policy significantly, however, the poverty headcount ratio increased when applied national poverty line which was explained by a high tax burden on poor people which even exceeded the amount of received transfers and subsidies [41]. [42] concluded that fiscal opacity might lead to the increase of inequality and poverty via destroying the redistributive taxation on economic growth.

As regards neutrosophic investigations, this approach has been applying in different spheres, including decision making [43], analysis of videoconferences in smart learning [44], forecasting cryptocurrency volatility [45], optimization of SME financing [46], fintech education in marketing [47], and etc.

From all these controversial results it is interesting to see what results will be obtained in case of Uzbekistan, and how economic growth and fiscal policy influence on the poverty rate.

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3. Data and Methodology

This paper aims at revealing the impact of economic growth and fiscal policy on poverty rate in Uzbekistan. In the analysis secondary data, obtained from the State Statistic Committee of the Republic of Uzbekistan, was used. The period of observation is 22 years from 2000 to 2021.

The dependent variable is poverty (poverty) measured by the share of population consuming less than 2,100 kilocalories per day., while the independent variables are natural logariphmed GDP per capita (lngdp), government budget expenditures to GDP (expensespercent), tax revenues to GDP (taxpercent). The descriptive statistics of the variables is given in Table 1.

This study is framed based on the concept of neutrosophic theory. Neutrosophic logic is a logic it is estimated that each proposition has a degree of truth (T), a degree of indeterminacy (I), and a degree of falsity (F), whilst neutrosophic set is a set where each element contains degrees of truth, indeterminacy and falsity, and lies between [0,1]*, which is the non-standard unit interval [9]. Initially Neutrosophic AHP method was applied, followed by ARDL and Vector Autoregression (VAR) models. These models are best in analyzing time series data. In addition, Granger causality tests were conducted separately between dependent and each independent variable to analyze the direction of effects between variables.

3.1. Neutrosophy Theory

The neutrosophic-AHP can be divided into several steps: building pairwise comparison matrices, computing each columns' total values, finding normalized values, and obtaining the weight of the criterion. The mathematical representation of the first step is the following [44]:

$$D = \begin{pmatrix} <[T_{11}^L, T_{11}^U], [I_{11}^L, I_{11}^U] [F_{11}^L, F_{11}^U]> & \dots & <[T_{m1}^L, T_{m1}^U], [I_{m1}^L, I_{m1}^U] [F_{m1}^L, F_{m1}^U]> \\ <[T_{m1}^L, T_{m1}^U], [I_{m1}^L, I_{m1}^U] [F_{m1}^L, F_{m1}^U]> & \dots & <[T_{mm}^L, T_{mm}^U], [I_{mm}^L, I_{mm}^U] [F_{mm}^L, F_{mm}^U]> \end{pmatrix}$$

where:

T- a degree of truth

I – a degree of indeterminacy

F- a degree of falsity

i= 1,2, …, m criteria

The second step can be illustrated in the following way [44]:

$$Sum_{ij} = ([\sum_{k=1}^{m} T_{kj}^L, \sum_{k=1}^{m} T_{kj}^U], [\sum_{k=1}^{m} I_{kj}^L, \sum_{k=1}^{m} I_{kj}^U], [\sum_{k=1}^{m} F_{kj}^L, \sum_{k=1}^{m} F_{kj}^U]$$

The third step can be expressed via the following formula [44]:

$$Nor_{ij} = ([\frac{T_{kj}^L}{\sum_{k=1}^{m} T_{kj}^L}, \frac{T_{kj}^U}{\sum_{k=1}^{m} T_{kj}^U}], [\frac{I_{kj}^L}{\sum_{k=1}^{m} I_{kj}^L}, \frac{I_{kj}^U}{\sum_{k=1}^{m} I_{kj}^U}], [\frac{F_{kj}^L}{\sum_{k=1}^{m} F_{kj}^L}, \frac{F_{kj}^U}{\sum_{k=1}^{m} F_{kj}^U}]$$

And the last step can be written in the following way [44]:

$$W_j = \frac{[\sum_{k=1}^{m} \frac{T_{kj}^L}{\sum_{k=1}^{m} T_{kj}^L}, \sum_{k=1}^{m} \frac{T_{kj}^U}{\sum_{k=1}^{m} T_{kj}^U}]}{m}, \frac{[\sum_{k=1}^{m} \frac{I_{kj}^L}{\sum_{k=1}^{m} I_{kj}^L}, \sum_{k=1}^{m} \frac{I_{kj}^U}{\sum_{k=1}^{m} I_{kj}^U}]}{m}, \frac{[\sum_{k=1}^{m} \frac{F_{kj}^L}{\sum_{k=1}^{m} F_{kj}^L}, \sum_{k=1}^{m} \frac{F_{kj}^U}{\sum_{k=1}^{m} F_{kj}^U}]}{m}$$

In this paper only the first step will be conducted, as based on this step further ARDL and VAR models will be created.

3.2. Unit root test

Before creating models, unit root tests were conducted to check the stationarity of the variables. Table 2 demonstrates the stationarity of data through Dickey–Fuller (DF) test, the Augmented Dickey–Fuller (ADF) Test, the Phillips–Perron (PP) test, and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test. From the results it can be seen that all the variables are stationary at significance level (I1) [48-51].

3.3. ARDL model

In order to check whether variables have a long-term relation, Autoregressive Distributive Lag Model (ARDL) is applied, which is also one of the most widely used methods in time series analysis [52-54]

The econometric form of the ARDL model is [52]:

$$y_t = c_0 + c_1 t + \sum_{i=1}^{p} \varphi_i y_{t-i} + \sum_{i=0}^{q} \beta'_i x_{t-i} + u_t$$

Where:

y - dependent variable

x – independent variable

c – constant

p and q – orders of lags

u_t - white noise

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3.4. VAR model

VAR method resembles superficially simultaneous-equation modeling where several endogenous variables are considered together, which are explained by their lagged values and lagged values of the remained endogenous variables, considered in the model [55-57].
Estimated VAR assumes that the relationship between variables is described by the following linear structural model [52]:
$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-1} + CD_t + u_t$
Where:
A - coefficient matrices for i=1,…,p
p – number of lags
C - coefficient matrix of potentially deterministic regressors with dimension (K×M)
u_t - white noise
D_t - (M×1) column vector holding the appropriate deterministic regressors, such as a constant, trend, and dummy and/or seasonal dummy variables.
The distinguish of VAR model is that it relates the k'th variable in vector y_t to past values of itself and all other variables in the system.
Moreover, in order to reveal the mutual relationship between poverty and other variables, Granger causality test is conducted. The econometric structure of this test is the following [52]:
$y_t = \sum_{i=1}^{m} \alpha_i y_{t-i} + \sum_{j=1}^{m} \beta_j x_{t-j} + \omega_1 + u_{1t}$
$x_t = \sum_{i=1}^{m} \gamma_i x_{t-i} + \sum_{i=1}^{m} \delta_j y_{t-j} + \omega_2 + u_{2t}$

4. Results and Discussion

This section illustrates and discusses the results of the created models.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
poverty	22	18.41	6.298	11	27.5
lngdp	22	14.652	1.554	11.791	16.862
taxpercent	22	19.457	4.304	11.697	28.5
expensespercent	22	20.762	4.094	15.542	29.5

Table 2 is the output of the first step of neutrosophic-AHP analysis. It shows the direction and degree of relationship between paired variables. From the results it can be seen that all the relationship is statistically significant at the level 1%. The relationship between poverty and logariphmed GDP is very high and negative (-0.96), whereas between poverty and the remaining variables is also high but positive. From these obtained results it can be seen that all variables can be used for creating time series models as all of them have a statistically significant relationship with the poverty rate.

Table 2: Pairwise comparison matrix.

Variables	(1)	(2)	(3)	(4)
(1) poverty	1.000			
(2) lngdp	-0.960 (0.000)	1.000		
(3) taxpercent	0.864 (0.000)	-0.894 (0.000)	1.000	
(4) expensespercent	0.545 (0.009)	-0.560 (0.007)	0.777 (0.000)	1.000

The study affirmed the variables' stationarity status using the DF, ADF, PP and KPSS tests. Results of these tests showed that all the variables are stationary at the first order of integration (see Table 2).

Table 3: Summary of the stationarity tests

	DF	ADF, lag 1	PP	KPSS

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	non constant	constant	trend	non constant	constant	trend	non constant	constant	trend	trend	notrend
poverty	-2.26 **	-0.05	-2.50	-4.46 ***	-1.51	-0.31	-0.65	-0.23	-10.26	0.249	2.16
D.poverty	-3.65 ***	-6.11 ***	-6.00 ***	-0.74	-1.57	-2.24	-14.53 ***	-18.74 ***	-17.18 *	0.186 **	0.251
lngdp	10.05	-3.97 ***	-1.51	2.07	-2.11	-1.15	0.334	-0.83	-3.12	0.479 ***	2.18 ***
D. lngdp	-1.42	-2.97 *	-3.68 **	-1.55	-2.76 *	-3.36 *	-1.63	-10.08	-15.97 *	0.063	0.908 ***
taxpercent	-1.71 *	-2.31	-1.5	-0.94	-1.78	-3.16	-0.71	-4.34	-8.02	0.201 **	1.75 ***
D.taxpercent	-3.36 ***	-3.34 **	-3.39 *	-3.63 ***	-4.00 ***	-4.44 ***	-13.12 ***	-13.80 **	-14.91	0.063	0.301
expensespercent	-0.80	-1.97	0.03	-0.07	-1.40	0.10	-0.37	-5.16	0.18	0.421 ***	0.891 ***
D. expensespercent	-2.97 ***	-2.84 *	-3.86 **	-1.99 **	-1.88	-3.30*	-11.78 **	-11.60 *	-17.77 *	0.0838	0.648 **

*** p<.01, ** p<.05, * p<.1*

To analyze the impact of independent variables on dependent variable, initially ARDL model was created.
Next, ARDL model was created. Initially, variables were made to the condition of stationarity, that was in the difference level of one, and the first difference of all variables was used. When conducted Durbin-Watson test, the result lied in the zone of indecision, from which conclusion on the existence of first level autocorrelation could not be derived. Breusch-Godfrey test showed that the second-level autocorrelation exists. Thus, the lags were chosen from one to two. So, in the ARDL model p=2. The results of the ARDL model are illustrated in Table 4. From these results it can be concluded that on the first-difference level of the poverty influences positively the second lag of the poverty itself and the second lag of the expenses to GDP, whereas the first lag of lngdp and the second lag of the taxes to gdp affect adversely. When the diagnostic test for parameter stability of this model was conducted, it showed that all the variables are stable.

Table 4: ARDL model output

D.poverty	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
poverty							
LD	.047	.164	0.29	.784	-.34	.434	
L2D	.471	.092	5.14	.001	.254	.687	***
lngdp							
D	-1.874	1.63	-1.15	.288	-5.728	1.98	
LD	-4.585	2.25	-2.04	.081	-9.905	.735	*
L2D	-.129	1.831	-0.07	.946	-4.459	4.201	
taxpercent							
D	-.064	.099	-0.64	.542	-.298	.171	
LD	-.014	.112	-0.12	.904	-.279	.251	
L2D	-.468	.135	-3.47	.01	-.788	-.149	**
expensespercent							
D	-.013	.078	-0.17	.873	-.196	.17	
LD	-.098	.103	-0.95	.373	-.342	.146	

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L2D	.36	.104	3.45	.011	.113	.606	**
Constant	.842	.407	2.07	.078	-.121	1.804	*

Mean dependent var	-0.816	SD dependent var	0.757
R-squared	0.936	Number of obs	19
F-test	9.362	Prob > F	0.003
Akaike crit. (AIC)	13.966	Bayesian crit. (BIC)	25.299

*** $p<.01$, ** $p<.05$, * $p<.1$

Finally, in order to analyze the relationship between variables, VAR model was created and its output is demonstrated in the Table 5. Before creating VAR model, autoregression checking test was conducted and results showed that there is a lag of the second order. Thus, into the VAR model second lag of all variables are included. From the results of the VAR model it can be concluded that the second lag of the poverty's difference has a positive and statistically significant impact on the poverty rate. So, one unit increase of poverty difference in one year will increase the poverty difference after two years by 0.501 units. Also the first level lag of lngdp and the second level lag of taxpercent affect poverty rate adversely, implying that a one unit increase of them will decrease poverty difference by 5.993 and 0.046 units respectively. As regards expensespercent, there is an interesting situation, its first order lag influences negatively on the poverty rate whereas its second order lag impacts positively.

Table 5: The output of the VAR model.

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_poverty	9	.281547	0.9231	228.0711	0.0000
D_lngdp	9	.066793	0.5584	24.02336	0.0023
D_taxpercent	9	1.17406	0.7790	66.96452	0.0000
D_expensesperc~t	9	1.49299	0.6404	33.83075	0.0000

Vector autoregression

Sample: 2003 - 2021		Number of obs	= 19
Log likelihood = -11.75012		AIC	= 5.026328
FPE = .0024882		HQIC	= 5.329177
Det(Sigma_ml) = .0000405		SBIC	= 6.815792

	Coef.	Std.Err.	z	P>z	[95%Conf.	Interval]
D_poverty						
poverty						
LD.	0.025	0.086	0.290	0.770	-0.143	0.193
L2D.	0.501	0.051	9.880	0.000	0.402	0.601
lngdp						
LD.	-5.993	1.068	-5.610	0.000	-8.086	-3.899
L2D.	0.274	0.909	0.300	0.763	-1.508	2.055
taxpercent						
LD.	-0.010	0.055	-0.190	0.852	-0.119	0.098
L2D.	-0.485	0.062	-7.870	0.000	-0.605	-0.364
expensespercent						
LD.	-0.160	0.054	-2.990	0.003	-0.265	-0.055
L2D.	0.394	0.061	6.500	0.000	0.275	0.513
_cons	0.673	0.219	3.070	0.002	0.243	1.102
D_lngdp						
poverty						
LD.	-0.032	0.020	-1.570	0.116	-0.072	0.008
L2D.	0.007	0.012	0.570	0.571	-0.017	0.030
lngdp						
LD.	0.119	0.253	0.470	0.639	-0.378	0.615

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L2D.	0.339	0.216	1.570	0.116	-0.084	0.761
taxpercent						
LD.	-0.032	0.013	-2.440	0.015	-0.058	-0.006
L2D.	0.046	0.015	3.120	0.002	0.017	0.074
expensespercent						
LD.	0.027	0.013	2.120	0.034	0.002	0.052
L2D.	-0.022	0.014	-1.510	0.130	-0.050	0.006
_cons	0.105	0.052	2.020	0.043	0.003	0.207
D_taxpercent						
poverty						
LD.	0.994	0.358	2.780	0.005	0.293	1.696
L2D.	-0.569	0.212	-2.690	0.007	-0.984	-0.155
lngdp						
LD.	15.894	4.454	3.570	0.000	7.164	24.624
L2D.	-13.069	3.790	-3.450	0.001	-20.498	-5.640
taxpercent						
LD.	0.828	0.231	3.590	0.000	0.376	1.280
L2D.	-1.025	0.257	-3.990	0.000	-1.529	-0.522
expensespercent						
LD.	0.083	0.224	0.370	0.710	-0.355	0.521
L2D.	0.162	0.253	0.640	0.521	-0.333	0.658
_cons	-0.742	0.914	-0.810	0.417	-2.534	1.050
D_expensespercent						
poverty						
LD.	1.433	0.455	3.150	0.002	0.540	2.325
L2D.	-0.559	0.269	-2.080	0.038	-1.086	-0.031
lngdp						
LD.	13.604	5.664	2.400	0.016	2.503	24.706
L2D.	-16.084	4.820	-3.340	0.001	-25.531	-6.636
taxpercent						
LD.	0.294	0.293	1.000	0.316	-0.281	0.869
L2D.	-0.301	0.327	-0.920	0.358	-0.941	0.340
expensespercent						
LD.	0.494	0.284	1.740	0.082	-0.063	1.051
L2D.	-0.322	0.321	-1.000	0.316	-0.952	0.308
_cons	1.480	1.163	1.270	0.203	-0.799	3.758

After creating VAR model, diagnostic tests were conducted to check the adequacy of the created model by conducting tests on the existence of the autocorrelation. The normality of the residuals' distribution and the stability of the coefficients. So, in the Table 6 are shown the results of the Lagrange-multiplier test, which tests the existence of the autocorrelation in the model. In this test H0 is the absence of the autocorrelation at lag order, so, from the result, it can be seen that the H0 is accepted, and the model does not have an autocorrelation issue.

Lagrange-multiplier test

Table 6: Result of the autocorrelation test.

lag	chi2	df	Prob>Chi2
1	17.526	16	0.352
2	17.903	16	0.330

H0: no autocorrelation at lag order

Table 7 shows the results of the Jarque-Bera, Skewness and Kurtosis tests on the normal distribution of the residuals. In these tests H0 means that the residuals are normally distributed. From the results of these tests it can be seen that the

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residuals of the model are normally distributed apart from the D.taxpercent. However, even this taxpercent does not impact on the distribution of the residuals in total negatively.

Table 7: Results of the tests on the normal distribution of the residuals.

	Jarque-Bera test			Skewness test				Kurtosis test			
Equation	***chi2***	***df***	***Prob > chi2***	***Skewness***	***chi2***	***df***	***Prob > chi2***	***Kurtosis***	***chi2***	***df***	***Prob > chi2***
D_poverty	0.457	2	0.795	0.15	0.071	1	0.789	2.302	0.386	1	0.535
D_lngdp	0.602	2	0.740	0.371	0.436	1	0.509	3.458	0.167	1	0.683
D_taxpercent	7.872	2	0.020	-1.106	3.875	1	0.049	5.247	3.998	1	0.045
D_expensespercent	2.029	2	0.362	0.798	2.017	1	0.155	2.878	0.012	1	0.914
ALL	10.960	8	0.203		6.399	4	0.171		4.561	4	0.335

Finally, the stability of the coefficients was checked using Eigenvalue stability condition, according to which the modulus should not exceed 1.0. The output of this test is given in Table 8. From the results it can be seen that no modulus exceeds 1.0, thus all the coefficients of the model are stable.

Table 8: Eigenvalue stability condition

Eigenvalue		Modulus
.1978306 +	.9655746i	.985632
.1978306 -	.9655746i	.985632
.857919		.857919
.473963 +	.49363i	.684333
.473963 -	.49363i	.684333
-.617956		.617956
-.4436342		.443634
.3257451		.325745

All the eigenvalues lie inside the unit circle. VAR satisfies stability condition.

Furthermore, Granger causality Wald tests was conducted separately to analyze the mutual impact of variables on poverty. Initially the impact of poverty and lngdp was analyzed, from the results it can be seen that lngdp in Uzbekistan case does not have an impact on poverty rate but poverty has impact on lngdp (see Table 9). So, there is one-direction causality.

Table 9: Granger causality Wald tests between poverty and lngdp

Equation	Excluded	chi2	df	Prob>Chi2
D_poverty	D.lngdp	1.653	3	0.648
D_poverty	ALL	1.653	3	0.648
D_lngdp	D.poverty	15.071	3	0.002
D_lngdp	ALL	15.071	3	0.002

From the Table 10 Granger causality test there is no causality between poverty and taxpercent

Table 10: Granger causality Wald tests between poverty and taxpercent

Equation	Excluded	chi2	df	Prob>Chi2
D_poverty	D.taxpercent	5.586	3	0.134
D_poverty	ALL	5.586	3	0.134
D_taxpercent	D.poverty	2.349	3	0.503
D_taxpercent	ALL	2.349	3	0.503

The relationship between poverty and expensespercent has also a uni-direction character, when poverty level affects expenses but expenses do not affect poverty (see Table 11).

Table 11: Granger causality Wald tests between poverty and expensespercent.

Equation	Excluded	chi2	df	Prob>Chi2

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D_poverty	D.expensespercent	1.146	3	0.766
D_poverty	ALL	1.146	3	0.766
D_expensespercent	D.poverty	7.138	3	0.068
D_expensespercent	ALL	7.138	3	0.068

5. Conclusion

Poverty is one of the most investigated and contradictive phenomena in the world, proving that there is no universal approach to measuring it as well as universal cure for treating it. Therefore, it is important for each country to conduct its own investigation on the causes of poverty and factors affecting it to develop the national strategies for poverty reduction. Although the interest in this topic has re-emerged in Uzbekistan recently after the decade of stagnation, a lot of work should be done to correctly evaluate the real situation in the country. There is a hope that this paper will contribute to shed the light on the impact of economic growth and fiscal policy on poverty rate in Uzbekistan case. To our best knowledge, this is the first paper focusing on Uzbekistan when analyzing the relationship between forementioned variables. The analysis process was conducted in several steps. Initially, the neutrosophic-AHP analysis was applied to see the level of correlation between variables, based on the results of which ARDL and VAR analysis were conducted. For conducting them, first, the stationarity of the variables was checked, and it was found that all the variables were stationary at the first order. Next, ARDL and VAR models were constructed, and the best model was selected based on AIC and BIC criteria. According to results, the best model was VAR model, the adequacy of which in the next stage was tested by postestimation tests as the normality of the residuals' distribution test, autocorrelation test, and the stability of the coefficients test. All these tests showed that the created model was adequate. From the results of the VAR model, it can be concluded that the second lag of the poverty's difference had a positive and statistically significant impact on the poverty rate. Also, it was revealed that economic growth affects poverty adversely with delay in one lag, whereas taxes – with two lags. Interesting situation occurred with government expenditures, which impacted negatively on poverty after a one-year lag, but positively after two lags. The next step was a conduction of Granger causality test, which gave an interesting result in the relationship between poverty and economic growth. The results showed that in Uzbekistan case the economic growth does not serve to the reduction of poverty rate, whilst the poverty causes the deterioration of the economic growth. The same situation can be observed with relationship between government expenditures and poverty rate, when the government expenditures do not affect poverty, but the poverty level affects expenses. Regarding taxes, no causality relationship was found between variables. From the obtained results the government can focus on more sustainable economic growth that would support poor population. One of the limitations of this research is a relatively small number of observations because of the lack of publicly available statistical data for the period of 20th century. For the further research the impact of separate governmental expenses as well as specific taxes on poverty rate can be investigated to more detailed impact of fiscal policy on poverty rate.

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