# INFLUENCE OF CONTRIBUTION RATE DYNAMICS ON THE PENSION PILLAR II ON THE EVOLUTION OF THE UNIT VALUE OF THE NET ASSETS OF THE NN PENSION FUND

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**Abstract:** As political decision-makers have recently proposed among other measures the reduction in the share of privately managed private pension funds (Pillar II) in Romania from 5.1%, currently at 2.5%, starting with January 2018, I propose to analyze through a unifactorial regression model the influence of the Pillar II contribution share on the unit value of the net asset (VUAN) and thus on the pension that the future pensioners of Pillar II will receive. I'm looking to get an econometric model that can be used to make forecasts and using specialized software to predict the VUAN level on December 31, 2017, given that the share of contributions will remain at 5.1%. At the same time, I intend to predict VUAN for the end of 2018, as from 1 January 2018 the quota will increase to 6%, but also if the quota drops to 2.5%.

**JEL classification: G23, G28, G29**

**Key words: Pilar II; Net Asset Unit Net Value; pension found; econometric model; linear regression.**

## 1. RESEARCH METHODOLOGY

Based on private funded private pension research, I decided to build a model to include the actual Pillar II contribution rates and the unit value of the net asset for the privately-managed private pension fund NN, fund that has dominated the market from the beginning to the present.

The shape of the model is:

$$VUAN = \beta_0 + \beta_1 * COTA \qquad (1)$$

where:

VUAN- the endogenous variable, ie the unit value of the net asset of the NN private pension fund;

COTA - the exogenous variable, represented by the contribution quota for the privately administered private pension funds (Pillar II) in Romania.

For the analysis of the correlations between the two variables of the model, I will use data with annual frequency found on the website of the Financial Supervisory Authority (ASF) in Romania (https://asfromania.ro/en/).

Using the EViews 9.5 Student / Lite Version software, I will estimate the model using the least squares method and test the validity of the model, the degree of model

reliability, the unifactorial regression model assumptions, and the statistical significance of the parameters included in the model

## 2. DATA USED. DEFINING VARIABLES OF MODEL

The Net Asset Unit Net Value (VUAN) is the pointer on which the amount of money actually available in the individual account of each participant is determined

The quota transferred to Pillar II has increased gradually from 2% in 2008 to 6% (percent of gross earnings) in 2016. This did not happen because the policy makers set the level of the quota for 2016 to 5.1%.It should be noted that this quota is mandatory only for those who have joined the scheme on a mandatory basis (under 35 years) but also for those who have joined Pillar II on a voluntary basis (between 35 and 45 years).

Table 1 presents the values recorded on December 31 by the two variables which I analyzed, in the period 2008-2016.

Table no. 1

|      | VUAN     | COTA  |
|------|----------|-------|
| 2008 | 10.98130 | 0.020 |
| 2009 | 13.11109 | 0.020 |
| 2010 | 15.13536 | 0.025 |
| 2011 | 15.43008 | 0.030 |
| 2012 | 17.01465 | 0.035 |
| 2013 | 18.93632 | 0.040 |
| 2014 | 20.68960 | 0.045 |
| 2015 | 21.53651 | 0.050 |
| 2016 | 22.39795 | 0.051 |

*Source: made by the author based on informations on www.asfromania.ro*

From the statistical data provided by EViews and presented in Figure no. 1 shows that the average contribution rate for the period between 2008 and 2016 was 3.5111%, with a standard deviation of 0.01215. Distribution has a slight positive asymmetry, with higher values being present on the left. The Skewness Asymmetry Coefficient has a value of 0.024201, very close to zero, ie a normal distribution, and the Kurtosis flattening coefficient is 1.538798, less than 3, which means a platykurtic distribution. Contribution rate rose from a minimum of 2% in 2008 to a maximum of 5.1% in 2016.



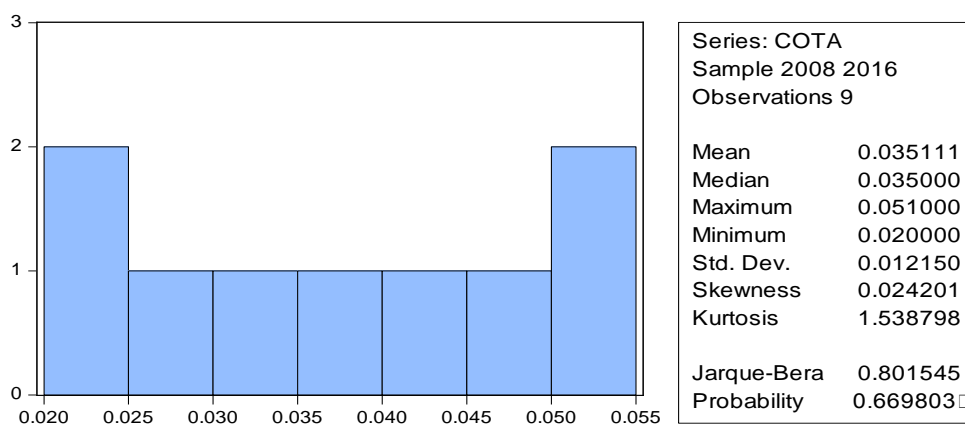| Series: COTA | |
|---|---|
| Sample 2008 2016 | |
| Observations 9 | |
| Mean | 0.035111 |
| Median | 0.035000 |
| Maximum | 0.051000 |
| Minimum | 0.020000 |
| Std. Dev. | 0.012150 |
| Skewness | 0.024201 |
| Kurtosis | 1.538798 |
| Jarque-Bera | 0.801545 |
| Probability | 0.669803 |

Figure no. 1 Descriptive Statistics of Contribution to Pension Pillar II in Romania

As I was saying, the unit value of the net asset (VUAN) is the indicator on the basis of which is determined the amount of money actually available in the individual account of each participant. The profitability of each pension fund is reflected in the value of the VUAN. The rate of return of a pension fund is the main performance indicator of a privately managed pension fund, whose calculation formulas are set by the rules issued by A.S.F.
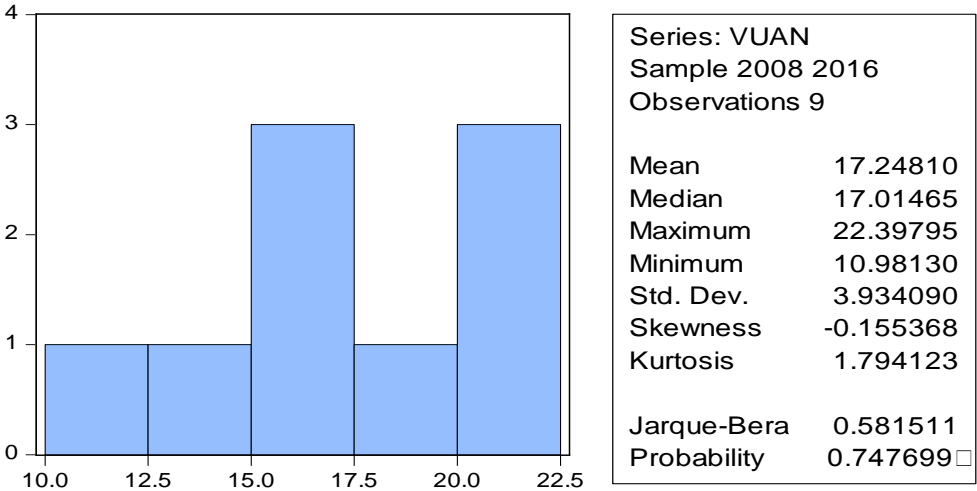


Figure no. 2 Descriptive Statistics of VUAN for privately administered private pension fund NN

Analyzing the statistical data obtained with EViews and presented in Fig. 2 shows that the average VUAN rate for the private NN pension fund for the period between 2008 and 2016 was 17,24810 lei, with a standard deviation of 3,934090. The distribution has a slight negative asymmetry, the higher values being present on the right side. The Skewness Asymmetry Coefficient has a value of -0.155368, close to zero, ie a normal distribution, and the Kurtosis flattening coefficient is 1.794123, less than 3, which means a platykurtic distribution. The value of the UUAN increased from a minimum of 10.98130 in 2008 to a maximum of 22.39795 lei reached in 2016.

The main descriptive statistics of the dependent variable (VUAN) and the independent variable (COTA) are presented in Figure no. 3.

Date: 09/27/17   Time: 21:47
Sample: 2008 2016

|  | VUAN | COTA |
| --- | --- | --- |
| Mean | 17.24810 | 0.035111 |
| Median | 17.01465 | 0.035000 |
| Maximum | 22.39795 | 0.051000 |
| Minimum | 10.98130 | 0.020000 |
| Std. Dev. | 3.934090 | 0.012150 |
| Skewness | -0.155368 | 0.024201 |
| Kurtosis | 1.794123 | 1.538798 |
| | | |
| Jarque-Bera | 0.581511 | 0.801545 |
| Probability | 0.747699 | 0.669803 |
| | | |
| Sum | 155.2329 | 0.316000 |
| Sum Sq. Dev. | 123.8165 | 0.001181 |
| | | |
| Observations | 9 | 9 |

Figure no. 3. The main descriptive statistics of the two variables (VUAN and COTA)

The contribution quota transferred to Pillar II has gradually increased, starting at 2% in 2008, reaching 20.1% in 5,1% of gross earnings, below the level of 6% it was supposed to reaches 2016. The 6% level has not been reached because the political decision-makers have decided that it is appropriate to leave a higher percentage of the Pillar II gross earnings to the public pension system in 2009, when the share was maintained at the level of 2% instead of increasing to 2.5% and 2016 when instead of recovering the 2009 surplus and reaching 6%, rising to only 5.1%. The evolution of the share of contributions to Pension Pillar II is shown in Figure no. 4.
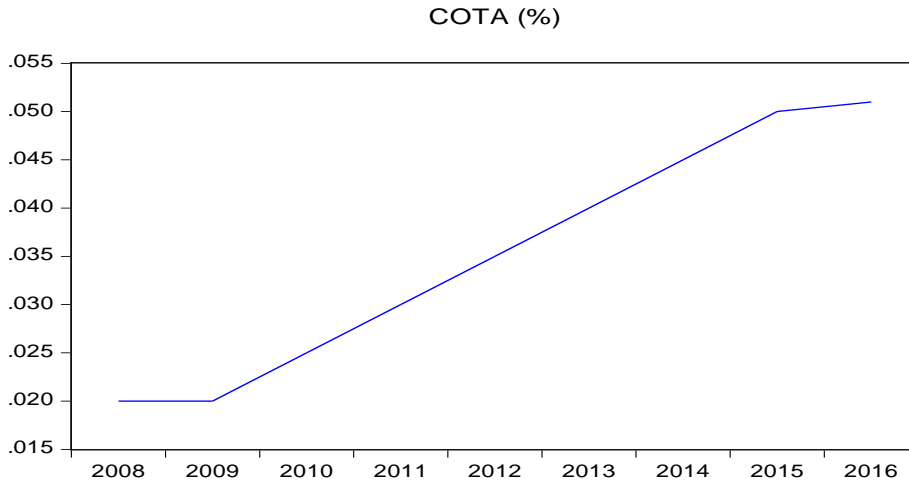
COTA (%)



Figure no. 4. Evolution of the share of contributions to the Pension Pillar II in Romania

As can be seen in Figure no. 5., the VUAN dynamics of the NN private pension fund, had an increasing trend during the period 2008-2016, with years of stronger growth (2008, 2009, 2011, 2012, 2013, 2014) and years in which growth was moderate (2010, 2015, 2016). I mention that the VUAN level is that recorded on December 31 of each year.
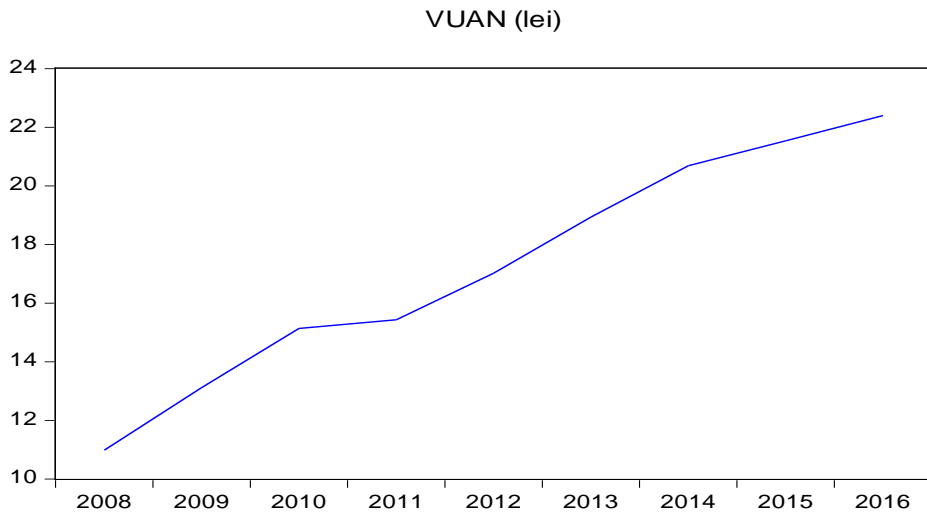
Figure no. 5. Evolution of the share of contributions to the Pension Pillar II in Romania

## 3. EMPIRICAL RESEARCH RESULTS

To determine the intensity of the link between the contribution quota (COTA) and the unit value of the net asset of the privately administered NN (VUAN) pension fund, I will determine the level of correlation between the two variables. The correlation indicates the intensity of the existing link between the two variables included in the econometric model by measuring the degree of scattering of data recorded around the regression line. For this, I will calculate the Pearson correlation coefficient:

$$r_{xy} = \sqrt{R^2} = R = 0{,}982938 \tag{2}$$

value which is generated in Figure no. 6. using EViews

|  | VUAN | COTA |
| --- | --- | --- |
| VUAN | 1.000000 | 0.982938 |
| COTA | 0.982938 | 1.000000 |

Figure no. 6. The correlation matrix of the two variables

Next, I will estimate the model parameters. Using the EViews software I analyzed the data series and estimated the regression model parameters by applying the least squares method, which generated the results presented in Figure no. 7.

```
Dependent Variable: VUAN
Method: Least Squares
Date: 09/27/17   Time: 21:52
Sample: 2008 2016
Included observations: 9
```

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 6.072892 | 0.831405 | 7.304372 | 0.0002 |
| COTA | 318.2811 | 22.51156 | 14.13857 | 0.0000 |
| R-squared | 0.966167 | Mean dependent var | | 17.24810 |
| Adjusted R-squared | 0.961334 | S.D. dependent var | | 3.934090 |
| S.E. of regression | 0.773589 | Akaike info criterion | | 2.517577 |
| Sum squared resid | 4.189075 | Schwarz criterion | | 2.561404 |
| Log likelihood | -9.329095 | Hannan-Quinn criter. | | 2.422997 |
| F-statistic | 199.8990 | Durbin-Watson stat | | 1.763967 |
| Prob(F-statistic) | 0.000002 | | | |

Figure no. 7. Parameter estimation via Least squares method (MCMMP)

The model equation is:

$$VUAN = \beta_0 + \beta_1 * COTA \qquad (3)$$

$$VUAN = 6,072892 + 318,2811 * COTA \quad (4)$$

The regression coefficient $\beta_1$ comes to complete the Pearson correlation coefficient and indicates a direct link between the econometric model variables. At the same time, we can say that an increase with a share of the contribution rate will attract a VUAN increase of 318.2811 lei.

The low value of free term $\beta_0$ indicates that the influence of factors not specified in the model on VUAN evolution is not significant, which leads to the conclusion that the model used is correct and can be further deepened to ensure better results.

The link between VUAN and COTA is direct and very strong one.

The determination coefficient (R-squared = 0.966167) shows that 96.6167% of the VUAN variation is explained by the evolution of the Pillar II contribution (COTA), the remainder being explained by factors not included in the econometric model. The adjusted determination coefficient (Adjusted R-squared = 0,961334) also takes into account the number of observations included (i = Included observations) and the explanatory variables.

The correlation ratio (R = 0.982938) tends to 1 and shows that the estimated regression model approximates the observation data well, with a degree of reliability that suggests that the model can be improved in the future to achieve better results. The mean square deviation of estimated errors (S.E. of regression) is 0.773589

I will continue the analysis by checking the significance of the parameters with test t:

$H_0: \beta_0 = 0$ ; $\beta_1 = 0$ (the parameters are not statistically significant, the model is not valid)

$H_1: \beta_0 \neq 0$ ; $\beta_1 \neq 0$ (the parameters are statistically significant, the model is valid)

Because $|t_{calc}| > t_{tab}$ for each of the two parameters, it follows that we can reject the null hypothesis and accept the alternative hypothesis, which means that all parameters

are statistically significant at the significance threshold of 5% chosen. The very low probability values for each model parameter reinforce that the parameters are statistically significant (Associated Prob. C = 0.0002 <5% and Associated Prob. COTA = 0.0000 <5%)

## 4. TESTING THE VALIDITY OF THE MODEL

To test the validity of the model we have the assumptions:

$H_0$: The model is not statistically valid (MSR=MSE)

$H_1$: The model is statistically valid (MSR>MSE)

We can safely assert that the model is statistically significant following the F test (F-statistic = 199,8990> $F_{critic}$), so I will reject the null hypothesis ($H_0$) and accept the alternative hypothesis ($H_1$), the model being valid for a significance level prob. (F-statistic) = 0.000002, less than 5%.

**Verifying the fulfillment of assumptions of simple linear regression model's**

The functional form is linear: $VUAN = 6,072892 + 318,2811 * COTA$

**The normality of distribution of random errors and their average**

To test the normality hypothesis of random errors I will use the Jarque-Bera test with the following assumptions:

$H_0$: random errors have normal distribution;

$H_1$: random errors do not have normal distribution

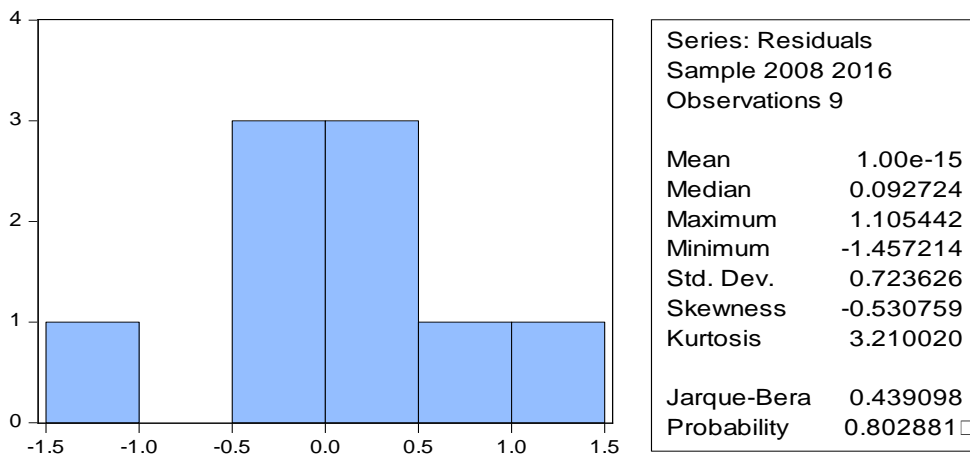| | |
|---|---|
| Series: Residuals | |
| Sample 2008 2016 | |
| Observations 9 | |
| | |
| Mean | 1.00e-15 |
| Median | 0.092724 |
| Maximum | 1.105442 |
| Minimum | -1.457214 |
| Std. Dev. | 0.723626 |
| Skewness | -0.530759 |
| Kurtosis | 3.210020 |
| | |
| Jarque-Bera | 0.439098 |
| Probability | 0.802881 |

Figure no. 8. Jarche-Bera Test

The probability associated with this test is 0.802881 which tends to 1, so I will accept the null hypothesis ($H_0$), random errors with normal distribution. It can be seen from Fig. 8. that the average random error is 1.00e-15, being very close to zero.

**Homoscedasticity of random errors**

To see if the random errors are homoscedastic or not, I will apply the following tests

**The White Test**

The test applies for the following assumptions:

$H_0$: there is homoscedasticity;

$H_1$: there is heteroscedasticity.

Heteroskedasticity Test: White

| | | | |
|---|---|---|---|
| F-statistic | 4.368022 | Prob. F(2,6) | 0.0675 |
| Obs*R-squared | 5.335516 | Prob. Chi-Square(2) | 0.0694 |
| Scaled explained SS | 3.566595 | Prob. Chi-Square(2) | 0.1681 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/27/17   Time: 21:56
Sample: 2008 2016
Included observations: 9

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.986596 | 2.160651 | 2.307914 | 0.0604 |
| COTA^2 | 2800.849 | 1872.577 | 1.495719 | 0.1854 |
| COTA | -237.5744 | 132.9502 | -1.786943 | 0.1242 |

| | | | |
|---|---|---|---|
| R-squared | 0.592835 | Mean dependent var | 0.465453 |
| Adjusted R-squared | 0.457113 | S.D. dependent var | 0.733922 |
| S.E. of regression | 0.540760 | Akaike info criterion | 1.869519 |
| Sum squared resid | 1.754528 | Schwarz criterion | 1.935261 |
| Log likelihood | -5.412836 | Hannan-Quinn criter. | 1.727649 |
| F-statistic | 4.368022 | Durbin-Watson stat | 3.019858 |
| Prob(F-statistic) | 0.067501 | | |

Figure no. 9. The White Test

We get that Prob. F for the calculated statistics is greater than 5% and 0.067501 respectively, so there is a high probability of error by rejecting the null hypothesis, so we accept the null hypothesis ($H_0$), according to which random errors are homoscedastic

**Non-autocorrelation of random errors**

**The Durbin-Watson Test**

I will use the Durbin-Watson Test with following assumptions:

$H_0: \rho = 0$ (there is no autocorrelation of first-order random errors);

$H_1: \rho \neq 0$ (there is autocorrelation of first-order random errors).

EViews provided in Figure no. 7. Durbin-Watson statistics = 1.763967 for the model analyzed.

Critical values of the Durbin-Watson statistic for a 5% significance threshold obtained from the table are dL = 0.824 and dU = 1.320.

Given that the Durbin-Watson statistic computed by EViews is larger than dU, it follows that I cannot reject the null hypothesis and accept it, which means that there is no autocorrelation of random order I errors.

**Projections based on the estimated linear regression model**

At this stage of econometric modeling, I will predict VUAN for the privately managed pension fund for the end of 2017 as the contribution rate remains unchanged by the end of this year, ie 5.1%.

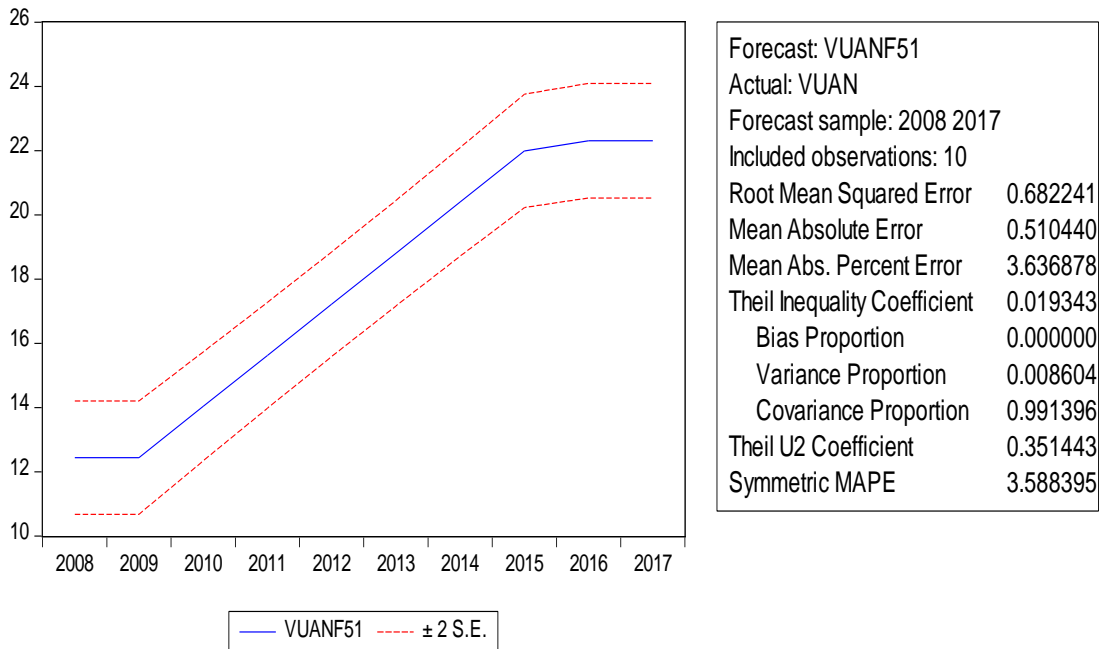| Forecast: VUANF51 | |
| Actual: VUAN | |
| Forecast sample: 2008 2017 | |
| Included observations: 10 | |
| Root Mean Squared Error | 0.682241 |
| Mean Absolute Error | 0.510440 |
| Mean Abs. Percent Error | 3.636878 |
| Theil Inequality Coefficient | 0.019343 |
| Bias Proportion | 0.000000 |
| Variance Proportion | 0.008604 |
| Covariance Proportion | 0.991396 |
| Theil U2 Coefficient | 0.351443 |
| Symmetric MAPE | 3.588395 |

Figure no. 10. VUAN Forecast for December 31, 2017

The forecast using EViews shows that VUAN will have the level of 22.3 lei at 31 December 2017. At the same time it can be guaranteed with a 95% probability that the UUAN level at 31 December 2017 will fall within the range of [20.5; 24.1].

To evaluate if the linear regression model is satisfactory and good to predict, I will graphically represent both the VUAN's predicted values (VUANF) and the real values of VUAN.
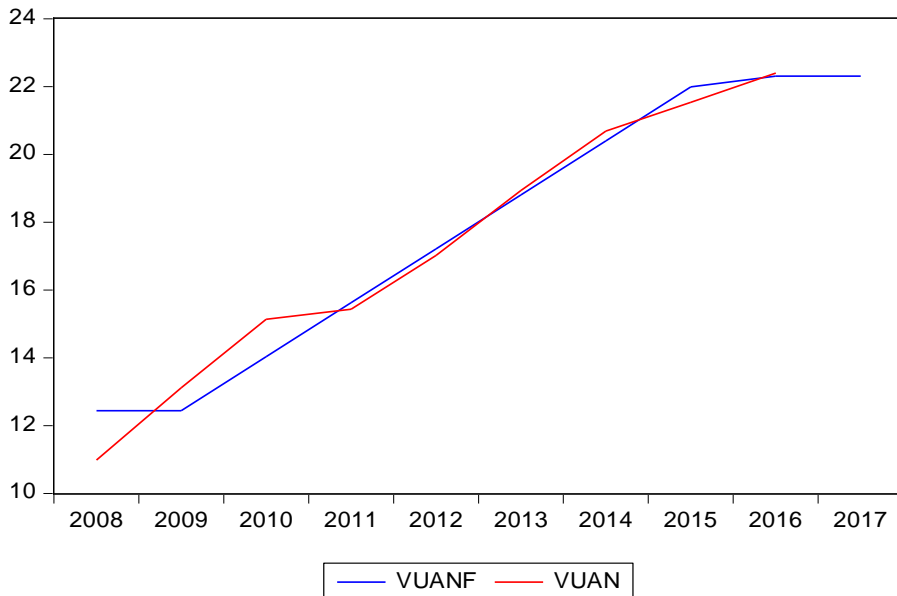
Figure no. 11. Evolution VUAN predicted (VUANF) and VUAN's evolution

The graph shows that the predicted value does not deviate significantly from the real value, indicating an econometric model that can be used successfully to make forecasts.

I will continue to forecast the VUAN level for the end of 2018 as the contribution rate will be increased to 6%.



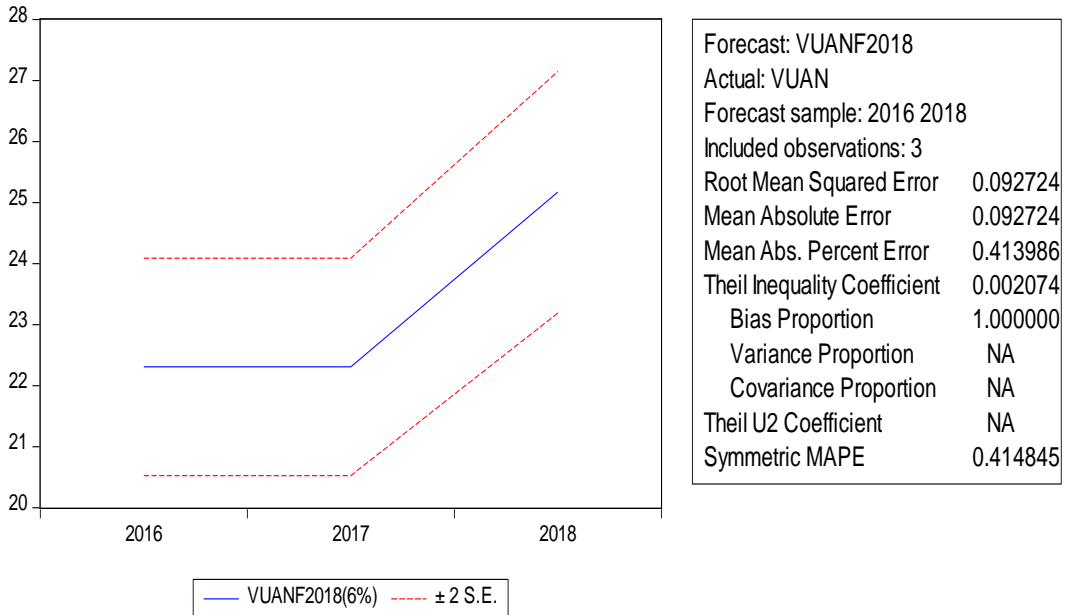| Forecast: VUANF2018 | |
| --- | --- |
| Actual: VUAN | |
| Forecast sample: 2016 2018 | |
| Included observations: 3 | |
| Root Mean Squared Error | 0.092724 |
| Mean Absolute Error | 0.092724 |
| Mean Abs. Percent Error | 0.413986 |
| Theil Inequality Coefficient | 0.002074 |
| Bias Proportion | 1.000000 |
| Variance Proportion | NA |
| Covariance Proportion | NA |
| Theil U2 Coefficient | NA |
| Symmetric MAPE | 0.414845 |

Figure no. 12. Evolution of VUAN under the influence of a 6% contribution rate in 2018

The forecast shows that VUAN will be at the level of 25.2 lei at 31 December 2018. At the same time it can be guaranteed with a 95% probability that the VUAN level at 31 December 2018 will fall within the range of [23.2; 27.1].
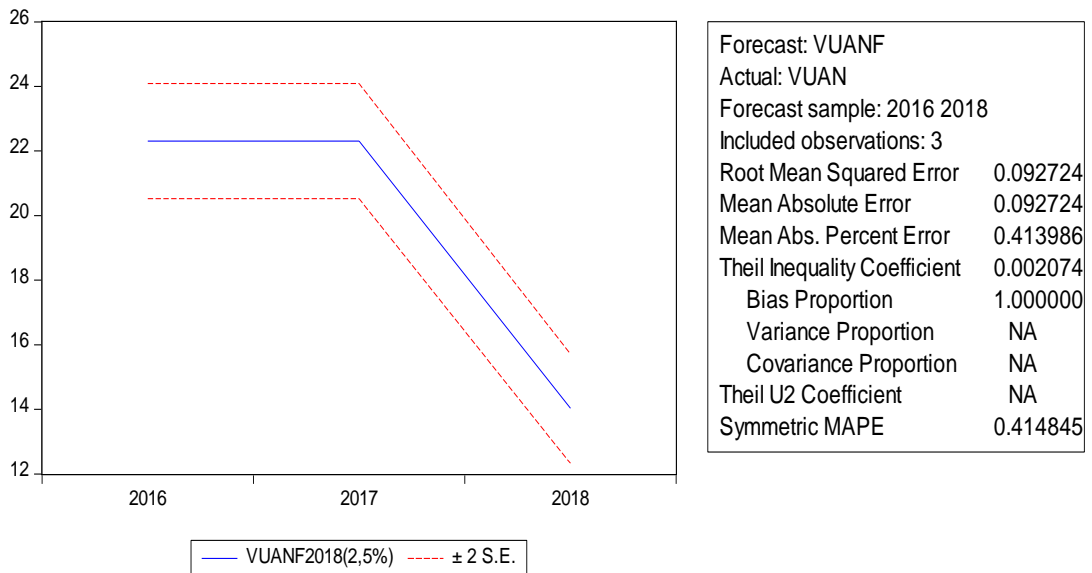
| Forecast: VUANF | |
|---|---|
| Actual: VUAN | |
| Forecast sample: 2016 2018 | |
| Included observations: 3 | |
| Root Mean Squared Error | 0.092724 |
| Mean Absolute Error | 0.092724 |
| Mean Abs. Percent Error | 0.413986 |
| Theil Inequality Coefficient | 0.002074 |
| Bias Proportion | 1.000000 |
| Variance Proportion | NA |
| Covariance Proportion | NA |
| Theil U2 Coefficient | NA |
| Symmetric MAPE | 0.414845 |

Figure no. 13. Evolution of VUAN under the influence of a contribution rate of 2.5% in 2018

If the contribution rate drops from 5.1% to 2.5% as of 1 January 2018, the forecast shows that VUAN will have the level of 14 lei at 31 December 2018. At the same time, it can be guaranteed with a 95% probability that the VUAN level at 31 December 2018 will fall within the range of [12.3; 15.7].

To illustrate the results obtained in the two cases I will represent graphically alongside the real evolution of VUAN and the two forecasts in Figure no. 14.
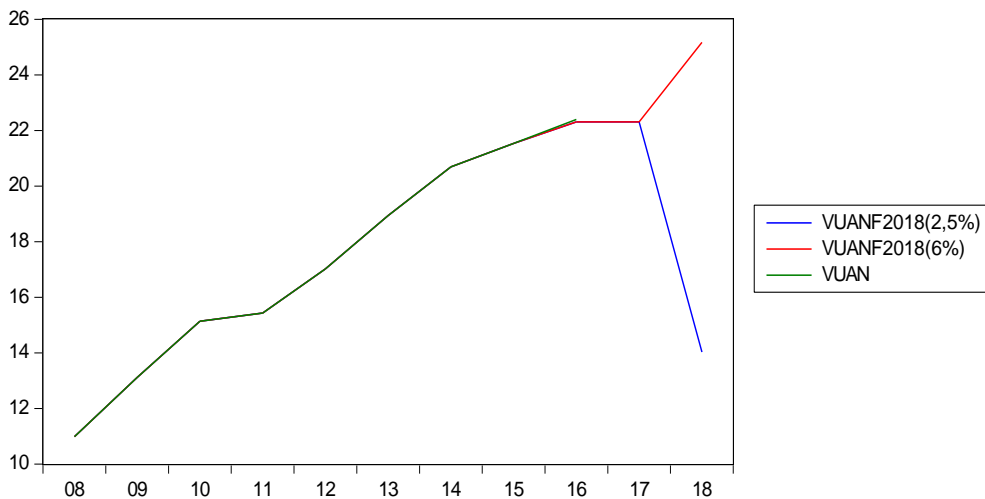


Figure no. 14. VUAN evolution and projected levels VUANF2018 (2.5%) and VUANF2018 (6%)

The results obtained by the two forecasts reveal divergent evolutionary trends of VUAN. VUAN, influenced by the contribution rate, will lead to diverging trends in the level of Pillar II pensions. This should be taken into account by policy makers when deciding on the share of contributions to privately managed pension funds

If we report the VUAN projected for December 31, 2018 at a 2.5% reduction in the contribution rate (VUANF2018 (2.5%)) at VUAN projected for the same date under the 6% increase in the contribution rate (VUANF2018 (6%)), we will notice that between the two levels there is a difference of 44.44%. This means almost half of the pension's level in the case of contribution 2.5%, compared to 6%.

## 5. CONCLUSIONS

As a result of the data processing, we obtained an econometric linear regression model with a high creditworthiness that manages to capture how the share of contribution to privately managed private pension funds (Pillar II) influences the evolution of the unit value of the net asset of the NN fund.

The unifactorial model resulting from the estimate is

$$VUAN = 6,072892 + 318,2811 * COTA \qquad (5)$$

The EViews program estimated the above model and obtained the following final results:

1. the R-squared confirms that the level of the share of contributions that apply to members' gross revenues influences the 96.6167% increase in the net asset value of the NN pension fund.
2. with a probability of 95% and for 7 degrees of freedom, using statistic we can assume that the hypothesis of correlation significance is verified and that there is a significant relation between the variables analyzed, so $r_{x/y}$ is statistically significant and the analysis model is correctly specified.
3. there is a significant direct relationship between the unit value of the NN fund net asset and the share of contributions to Pillar II. It can be said that an increase in the share of contributions will lead to an increase of 318.2811 VUAN monetary units.

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