Study of the Dynamics of the Net Asset Value of Voluntary Private Pension Funds under the Influence of the Annualized Rate of Return

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Abstract

In this article I will start from the idea that "the profitability of an optional private pension fund has repercussions on the unit value of the net asset, which is able to directly influence the level of amounts accumulated in the individual accounts of participants, I consider it useful to know the dependency relationship between the annualized rate of return and the unit value of the net asset" (Durac, 2018). With the help of the software EViews 10+ Student Version Lite I aim to obtain a valid econometric model with which I can forecast the levels of the unit value of the net asset (VUAN) depending on the evolution of the annualized rate of return. After obtaining a valid model, I will forecast the level of the unit value of the net asset for the period 2020-2025 in the conditions in which the annualized rate of return of the fund will keep its evolution trend over the entire forecast period.

Key words: voluntary pension funds, pilar III, econometric model, linear regression, net asset value
J.E.L. classification: G23, G28, G29.

1. Introduction

To assess the impact of the return of an optional private pension fund on the unit value of net assets, we constructed an econometric model in which we included the real values of the annualized rates of return of the optional private pension fund AZT VIVACE as well as the unit values of net assets recorded on the last day of December 2009-2019. I specify that the market of private pension funds in Romania is formed at the time of the study from a number of 10 funds, from that I chose the AZT VIVACE fund because it recorded the highest annualized rate of return in December 2019.

The shape of the model is:

$$VUAN = \beta_0 + \beta_1 * RRA$$

Where:

VUAN –the explained variable, i.e. the unit value of the net assets of the voluntary pension fund on 31 December of the years 2009-2019;

RRA –explanatory variable, represented by the annualized rate of return of the voluntary pension fund AZT VIVACE, registered in December in the period 2009-2019.

The data which I used have an annual frequency and were obtained by processing the data published on the website of the Romanian Financial Supervisory Authority. These were processed with EViews 10+ Student Version Lite software. I estimated the model using the least squares method and I tested: the validity of the unifactorial regression model for the chosen background, the degree of creditworthiness of the resulting model, the assumptions of the unifactorial regression model and the statistical significance of the parameters. After obtaining the econometric model, I will use it to forecast the VUAN level for the period 2020-2025

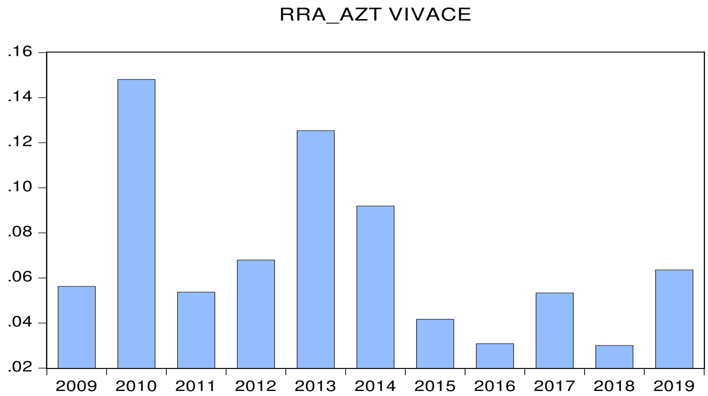
2. Research methodology

The unit value of net assets (VUAN) is the indicator based on which the amount of money actually available in the personal account of each participant in an optional pension fund at a given time is established.

The annualized rate of return of a privately managed pension fund "shall be determined by dividing by 2 the rate of return of that fund, measured for the period of the last 24 months prior to the calculation" (A.S.F., 2010).

The annualized rate of return of the AZT VIVACE pension fund had an oscillating evolution in accordance with the evolution of the financial markets, VUAN as can be seen in Chart no. 1.

Chart no.1 Evolution of the annualized rates of return of the AZT VIVACE fund in the period 2009-2019



Source: Made by the author based on data published on www.asfromania.ro, accessed on 14.03.2020

In Table no. 1 presents the values registered on December 31 by the two variables that are the object of the analysis in the period 2009-2019, for the AZT VIVACE fund.

Table no. 1 Values recorded on 31 December by VUAN and RRA for the AZT VIVACE fund

	RRA_AZT_VIVACE	VUAN_AZT_VIVACE
2009	0.056262	11.36112
2010	0.148046	12.60150
2011	0.053708	12.63390
2012	0.067996	14.25815
2013	0.125367	15.99391
2014	0.091919	16.98634
2015	0.041597	17.35224
2016	0.030763	18.02241
2017	0.053313	19.24205
2018	0.030064	19.08786
2019	0.063529	21.75835

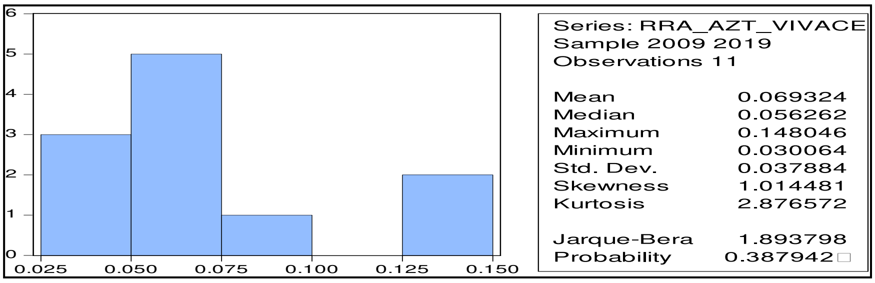
Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

The statistical data collected, for which EViews 10+ Student Version Lite generated Table no. 1 will be the basis for the subsequent processing.

EViews presents the descriptive statistics for the annualized rates of return of the AZT VIVACE fund in Chart no. 2. From these statistics it is observed that the average level of annualized rates of return for the period between 2009 and 2019 was 6.9324%, and the standard deviation (Std. Dev.) Was 0.037884.

The distribution shows a positive asymmetry, the higher values being present on the left side. This is highlighted by the Skewness asymmetry coefficient which has the value 1.014481.

Chart no. 2 Descriptive statistics of the annualized rates of return related to the AZT VIVACE fund



Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

Regarding the Kurtosis flattening coefficient, we can notice that it has a value of 2.876572, less than 3, which shows that the distributions have a platicurtic shape.

The value of the annualized rate of return decreased from the maximum value registered in 2010 of 14.8046%, to the minimum value of 3.0064% registered in 2018.

3. The results of empirical research

To determine the intensity of the link between the annualized rate of return (RRA) and the unit value of net assets (VUAN) I will calculate the level of correlation between the two variables. The correlation indicates the intensity of the link between the two variables included in the econometric model and is highlighted by the Pearson correlation coefficient:

$$r_{xy} = \sqrt{R^2} = R$$

For the two variables associated with the AZT VIVACE fund the correlation coefficient is $r_{RRA,VUAN} = \sqrt{R^2} = R = -0{,}365621$, which can be easily observed in the correlation matrix provided by EViews 10+ Student Version Lite in Table no. 2

Table no. 2 The correlation matrix of VUAN and RRA for the AZT VIVACE fund

	VUAN_AZT_VIVACE	RRA_AZT_VIVACE
VUAN_AZT_VIVACE	1.000000	-0.365621
RRA_AZT_VIVACE	-0.365621	1.000000

Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

Next, I will analyze the data series and estimate the parameters of the regression model by applying the method of least squares (Least squares). The generated results are presented in Table no. 3.

Table no.3 Estimation of regression parameters by MCMMP (Least squares) for the AZT VIVACE fund

Dependent Variable: VUAN_AZT_VIVACE
Method: Least Squares
Date: 03/14/20 Time: 12:39
Sample: 2009 2019
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RRA_AZT_VIVACE	-31.50191	26.73154	-1.178455	0.2688
C	18.48364	2.089600	8.845539	0.0000

R-squared	0.133679	Mean dependent var	16.29980
Adjusted R-squared	0.037421	S.D. dependent var	3.264062
S.E. of regression	3.202408	Akaike info criterion	5.328649
Sum squared resid	92.29874	Schwarz criterion	5.400993
Log likelihood	-27.30757	Hannan-Quinn criter.	5.283045
F-statistic	1.388755	Durbin-Watson stat	0.677700
Prob(F-statistic)	0.268833		

Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

In the case of the AZT VIVACE fund, the equation of the econometric model has the form:

$$VUAN\_AZT\_VIVACE = \beta_{0AZT\_VIVACE} + \beta_{1AZT\_VIVACE} \times RRA\_AZT\_VIVACE$$

$$VUAN\_AZT\_VIVACE = 18{,}48364 - 31{,}50191 \times RRA\_AZT\_VIVACE$$

The regression coefficient β_{1AZT_VIVACE} indicates an indirect link between the variables of the econometric model. An increase of 1% of the annualized rate of return of the AZT VIVACE fund (RRA_AZT_VIVACE) will attract the reduction of VUAN_AZT_VIVACE by 31.50191.

The high value of the free term β_{0AZT_VIVACE} shows that there are factors that have a significant influence on the evolution of VUAN_ AZT_VIVACE that were not included in the model.

The link between VUAN_ AZT_VIVACE and RRA_ AZT_VIVACE is indirect and weak in intensity, indicated by the coefficient of determination (R-squared = 0.133679) which shows that 13.3679% of the variation of VUAN_ AZT_VIVACE is explained by the evolution of the annualized rate of return AZT VIVACE fund (RRA_ AZT_VIVACE)..

The adjusted coefficient of determination also has a modest value (Adjusted R-squared = 0.037421.

The correlation ratio (R = -0.365621) indicates a weak and indirect correlation between the variables of the estimated regression model, and the creditworthiness of the model being low requires its correction. The mean square deviation of the estimated errors (S.E. of regression) has the value of 3.202408.

In the next step, I will check the significance of the parameters for the econometric model using the t-Statistic test.

4. Testing the significance of the parameters

Testing the significance of the parameters in the case of the AZT VIVACE fund starts from the formulation of two hypotheses:

$H_{0AZT\_VIVACE}: \beta_{0AZT\_VIVACE} = 0;\ \beta_{1AZT\_VIVACE} = 0$ (the parameters are not statistically significant, the model is not valid);

$H_{1AZT\_VIVACE}: \beta_{0AZT\_VIVACE} \neq 0;\ \beta_{1AZT\_VIVACE} \neq 0$ (the parameters are statistically significant).

We obtain the value of the t test statistic that is generated in the t-Statistical column, on the line of each estimated parameter, as can be seen in Table no. 3. It may be noted that $\beta_{0AZT\_VIVACE}: |t_{calcAZT\_VIVACE}| = 8{,}845539$, and $\beta_{1AZT\_VIVACE}: |t_{calcAZT\_VIVACE}| = 1{,}178455$. The resulting values are compared with the value of the t-Statistical distribution ($t_{tabAZT\_VIVACE} = 2{,}262$), for n-2 degrees of freedom and a chosen significance threshold of 5%.

Given that the parameter $\beta_{1AZT\_VIVACE}: |t_{calcAZT\_VIVACE}| < t_{tabAZT\_VIVACE}$) we cannot reject the null hypothesis and continue the analysis. But the probability associated with the parameter β_{1AZT_VIVACE} $(0{,}2688)$ being higher than 5% indicates the acceptance of the null hypothesis.

Following the application of the t-Statistic test for the econometric model, we can say that the parameters are not statistically significant.

5. Testing the validity of the model

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

H_0: the model is not statistically valid;

H_1: the model is statistically valid.

"In order to test the validity of the regression model, the F test is used, having the following form:

$$F = \frac{R^2}{1 - R^2} \times \frac{n - k}{k - 1}$$

Where n is the number of observations and k - the number of model parameters. From the Fisher distribution table, depending on a significance threshold α = 0.05 and the number of degrees of freedom" (Andrei T., 2008, p. 120), $v_1 = k - 1 = 1$ și $v_2 = n - k = 11 - 2 = 9,$ is taken over: $F_{critic} = F_{0{,}05;1;9} = 5{,}117$.

In the case of the AZT VIVACE fund, the null hypothesis (H_{0AZT_VIVACE}) is not rejected because$F - statistic_{AZT_VIVACE} = 1{,}388755 < F_{criticAZT_VIVACE} = 5{,}117$)), which means that the model is not statistically significant.

In conclusion, the econometric model associated with the AZT VIVACE fund is not valid for a significance level higher than 5%.

6. Verification of the fulfillment of the hypotheses of the simple linear regression model

In order to be able to estimate the parameters of the regression models it is necessary to verify if the classical hypotheses of the simple linear regression model are fulfilled.

The functional form is linear for the econometric model:

$VUAN\_AZT\_VIVACE = 18{,}48364 - 31{,}50191 \times RRA\_AZT\_VIVACE$;

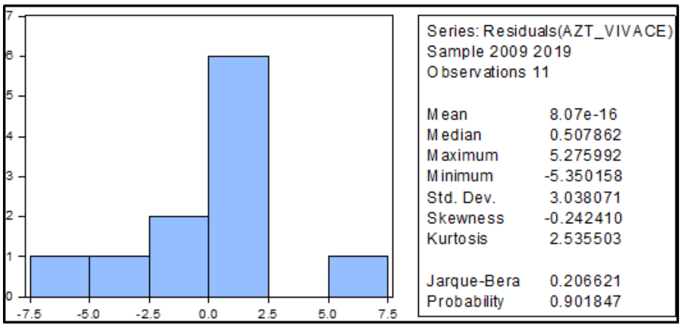
6.1. Normal distribution of random errors and their average

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

H_0: random errors have normal distribution;

H_1: random errors do not have a normal distribution.

Graph no. 3 The Jarque-Bera test(AZT VIVACE)



Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

Since the probability associated with the Jarque-Bera test is 0.901847, higher than the significance threshold of 5%, I will accept the null hypothesis (H_{0AZT_VIVACE}), the random errors having a normal distribution. It can be seen from Graph no. 3. that the average of the random errors is very small: $8{,}07\text{e} - 16 = \frac{8{,}07}{10^{16}}$,being very close to zero.

Because the probabilities associated with the Jarque-Bera test are much higher than the chosen significance threshold (5%), we can conclude that the random errors have a normal distribution for the econometric model associated with the AZT VIVACE fund.

6.2. Homoscedasticity of random errors

To see if the random errors are homoscedastic or heteroskedastic, I will apply the White Test for the following hypotheses:

H_0: there is homoscedasticity;

H_1: there is heteroskedasticity.

Applying the White Test in EViews 10+ Student Version Lite generates the results presented in Table no. 4, corresponding to the econometric model associated with the AZT VIVACE fund.

Table no. 4 The White Test – AZT VIVACE

Heteroskedasticity Test: White			
Null hypothesis: Homoskedasticity			
F-statistic	1.187586	Prob. F(2,8)	0.3535
Obs*R-squared	2.518212	Prob. Chi-Square(2)	0.2839
Scaled explained SS	1.294234	Prob. Chi-Square(2)	0.5236

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/14/20 Time: 12:59
Sample: 2009 2019
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-11.32860	17.67621	-0.640895	0.5395
RRA_AZT_VIVACE^2	-3848.476	2687.657	-1.431908	0.1901
RRA_AZT_VIVACE	623.6742	479.5251	1.300608	0.2296

R-squared	0.228928	Mean dependent var	8.390794
Adjusted R-squared	0.036160	S.D. dependent var	10.90498
S.E. of regression	10.70600	Akaike info criterion	7.806486
Sum squared resid	916.9469	Schwarz criterion	7.915003
Log likelihood	-39.93567	Hannan-Quinn criter.	7.738081
F-statistic	1.187586	Durbin-Watson stat	0.844581
Prob(F-statistic)	0.353491		

Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

As can be seen in Table no. 4, $Prob.(F - statistic) = 0{,}3535$ is higher than the chosen significance threshold of 5%, reason for which I will accept the null hypothesis, i.e. I accept the existence of homoskedasticity

6.3. Non-autocorrelation of random errors

To identify first-order autocorrelation, I will apply the Durbin – Watson Test. To test the autocorrelation of the errors I will estimate the model by the least squares method and I will calculate the residues u_t. I will calculate the dw statistic and select from the Durbin – Watson test tables the critical values dL and dU, for k - the number of explanatory variables in the model and n - the sample size. If dU ≤ dw ≤ 4 - dU, then the null hypothesis indicating the lack of first order autocorrelation is not rejected.

The assumptions for the Durbin-Watson Test are:

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 I).

Durbin-Watson statistics = 0.6777700 for the model associated with the AZT VIVACE fund can be seen in Table no. 5.

Since the calculated Durbin-Watson statistic is less than dL = 0.93, I will accept the null hypothesis, which means that there is a positive autocorrelation of first-order random errors in the case of the model associated with the AZT VIVACE fund.

After applying the Durbin-Watson Test in EViews 10+ Student Version Lite, I came to the conclusion that the hypothesis regarding the non-autocorrelation of random errors for the analyzed econometric model is not observed and I will adjust it by differentiating the variables. The equation of the adjusted model associated with the AZT VIVACE fund are:

$D(VUAN\_AZT\_VIVACE) = \beta_{0AZT\_VIVACE} + \beta_{1AZT\_VIVACE} \times D(RRA\_AZT\_VIVACE)$,

where:

$$D(VUAN\_AZT\_VIVACE) = VUAN\_AZT\_VIVACE - VUAN\_AZT\_VIVACE(-1)$$

and

$D(RRA\_AZT\_VIVACE) = RRA\_AZT\_VIVACE - RRA\_AZT\_VIVACE(-1)$.

Table no.5 Estimation of parameters by MCMMP (Least squares) for the AZT VIVACE background after adjusting the model

Dependent Variable: D(VUAN AZT VIVACE)
Method: Least Squares
Date: 03/14/20 Time: 13:07
Sample (adjusted): 2010 2019
Included observations: 10 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RRA AZT VIVACE)	10.75118	4.043435	2.658924	0.0289
C	1.031910	0.209155	4.933706	0.0011

R-squared	0.469140	Mean dependent var	1.039723
Adjusted R-squared	0.402782	S.D. dependent var	0.855774
S.E. of regression	0.661341	Akaike info criterion	2.187763
Sum squared resid	3.498977	Schwarz criterion	2.248280
Log likelihood	-8.938813	Hannan-Quinn criter.	2.121376
F-statistic	7.069876	Durbin-Watson stat	1.977293
Prob(F-statistic)	0.028854		

Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

The equation of the adjusted model becomese:

$$(VUAN\_AZT\_VIVACE) \ = \ 1{,}031910 + 10{,}75118 \times D(RRA\_AZT\_VIVACE)$$

The regression coefficient $\beta_{1AZT\_VIVACE} = 10$ indicates a direct link between the variables of the econometric model, complementing the Pearson correlation coefficient (0.684939). The increase by one unit of D(RRA_AZT_VIVACE) will lead to an increase by 10.75118 lei of D(VUAN_ AZT_VIVACE).

The small value (1.031910) of the free term β_{0AZT_VIVACE} shows an insignificant influence of the factors not specified in the model on the evolution of D (VUAN_ AZT_VIVACE).

The connection between the two indicators is direct and of medium intensity, the coefficient of determination (R-squared = 0.469140) showing that 46.914% of the variation D (VUAN_AZT_VIVACE) is explained by the evolution D (RRA_ AZT_VIVACE), the rest of the variation can be explained of other factors that are not included in the econometric model.

From Table no. 5 we observe the adjusted coefficient of determination (Adjusted R-squared = 0.402782) which also takes into account the number of explanatory variables and observations included (i = Included observations) in the model.

The correlation ratio (R = 0.684939) tends to 1 and shows that the estimated regression model approximates the observation data well, having an average creditworthiness that suggests that the model can be adjusted in the future to obtain better results. The mean square deviation of the estimated errors (S.E. of regression) is 0.661341.

The next stage of the analysis aims to verify the significance of the parameters for the econometric model adjusted using the t-Statistic test, which determines the ability of the independent variable to significantly influence the level of the dependent variable.

7. Testing the significance of the parameters

Testing the significance of the parameters in the case of the AZT_VIVACE fund involves defining the two hypotheses:

$H_{0AZT\_VIVACE}: \beta_{0AZT\_VIVACE} = 0$; $\beta_{1AZT\_VIVACE} = 0$ (the parameters are not statistically significant, the model is not valid);

$H_{1AZT\_VIVACE}: \beta_{0AZT\_VIVACE} \neq 0$; $\beta_{1AZT\_VIVACE} \neq 0$ (the parameters are statistically significant, the model is valid).

With EViews the value of the t test statistic is obtained (generated in the t-Statistic column), on the line of each estimated parameter, as it is observed in Table no. 5. It can be noticed that $\beta_{0AZT\_VIVACE}: |t_{calcAZT\_VIVACE}| = 4{,}933706$, and $\beta_{1AZT\_VIVACE}: |t_{calcAZT\_VIVACE}| = 2{,}658924$. The values are compared with the value of the t-Statistical distribution ($t_{tabAZT\_VIVACE} = 2{,}306$), for n-2 degrees of freedom and a chosen significance threshold of 5%.

Given that the parameter $\beta_{0AZT\_VIVACE}: |t_{calcAZT\_VIVACE}| > t_{tabAZT\_VIVACE}$ and the parameter $\beta_{1AZT\_VIVACE}: |t_{calcAZT\_VIVACE}| > t_{tabAZT\_VIVACE}$), it follows that the hypothesis is rejected and accepted alternative, which shows that the parameters are statistically significant at the chosen significance threshold of 5%.

The very low probabilities for the model parameters support the fact that the parameters are statistically significant (Associated Prob. C = 0.0011 <5% and Associated Probe D (RRA_AZT_VIVACE) = 0.0289 <5%).

Following the application of the t-Statistic test for the adjusted econometric model, we can say that the parameters are statistically significant.

8. Model validity testing

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

H_0: model is not statistically valid;

H_1: model is statistically valid.

"In order to test the validity of the regression model, the F test is used, having the following form:

$F = \frac{R^2}{1-R^2} \times \frac{n-k}{k-1}$,

where n – number of observations and k – the number of model parameters. From the Fisher distribution table, depending on a significance threshold α = 0.05 and the number of degrees of freedom " (Andrei T., 2008, p. 120), $v_1 = k - 1 = 1$ și $v_2 = n - k = 10 - 2 = 8$, take the value: $F_{critic} = F_{0,05;1;8} = 5{,}318$.

We can say that in the case of the AZT VIVACE fund the null hypothesis (H_{0AZT_VIVACE}) is rejected and the alternative one is accepted (H_{1AZT_VIVACE}) because $F - statistic_{AZT\_VIVACE} = 7{,}069876 > F_{criticAZT\_VIVACE} = 5{,}318$, which means that the model is statistically significant. The model being valid for a significance level Prob. (F-statistic) = 0.000926, less than 5%.

In conclusion, the adjusted econometric model associated with the AZT VIVACE fund is valid for a significance level of less than 5%.

9. Verification of the fulfillment of the hypotheses of the simple linear regression model

The functional form is linear for the adjusted econometric model:

$$D(VUAN\_AZT\_VIVACE) = 1{,}031910 + 10{,}75118 \times D(RRA\_AZT\_VIVACE)$$

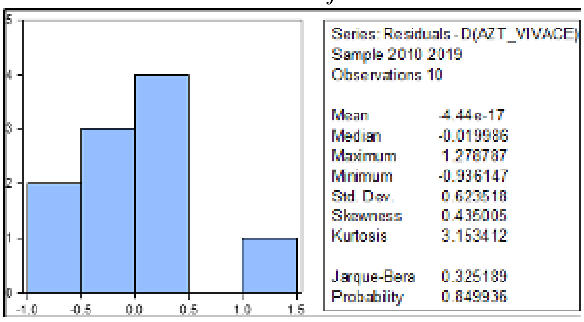
9.1 The normality of the distribution of random errors and their average

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

H_0: random errors have normal distribution;

H_1: random errors do not have normal distribution.

Graph no.4 The Jarque-Bera Test – AZT VIVACE adjusted



Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

Since the probability associated with the Jarque-Bera test is 0.849936, higher than the significance threshold of 5%, the null hypothesis will be accepted, the random errors having a normal distribution. It can be seen from Graph no. 4 that the average of the random errors is very small: $4{,}44\text{e} - 17 = 4{,}44 \times 10^{-17}$), being a value very close to zero. Because the probabilities associated with the Jarque-Bera test are much higher than the chosen significance threshold (5%), we can conclude that the random errors have a normal distribution after adjustment for the econometric model associated with the AZT VIVACE fund

9.2 Homoscedasticity of random errors

To see if the random errors are homoscedastic or not, I will apply the White Test with the assumptions:

H_0: there is homoscedasticity;

H_1: there is heteroskedasticity.

Applying the White test in EViews 10+ Student Version Lite generates the results presented in Table no. 6.

Table no. 6 The White Test – AZT VIVACE adjusted

Heteroskedasticity Test: White			
Null hypothesis: Homoskedasticity			
F-statistic	0.453639	Prob. F(2,7)	0.6528
Obs*R-squared	1.147397	Prob. Chi-Square(2)	0.5634
Scaled explained SS	0.790662	Prob. Chi-Square(2)	0.6735

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/14/20 Time: 13:19
Sample: 2010 2019
Included observations: 10

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.392172	0.239773	1.635596	0.1459
D(RRA_AZT_VIVACE)^2	-16.66612	58.05730	-0.287063	0.7824
D(RRA_AZT_VIVACE)	3.191514	3.530714	0.903929	0.3961

R-squared	0.114740	Mean dependent var	0.349898
Adjusted R-squared	-0.138192	S.D. dependent var	0.541232
S.E. of regression	0.577419	Akaike info criterion	1.982828
Sum squared resid	2.333890	Schwarz criterion	2.073604
Log likelihood	-6.914142	Hannan-Quinn criter.	1.883248
F-statistic	0.453639	Durbin-Watson stat	0.732659
Prob(F-statistic)	0.652752		

Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

After applying the White Test, for the econometric model associated with the AZT VIVACE fund, we find that $Prob.(F - statistic) = 0{,}6528$. Because this probability is higher than the chosen significance threshold (5%), we say that there is a high probability (65.28%) of being wrong if we reject the null hypothesis, so we will accept it by saying that there is homoscedasticity.

In conclusion, the adjusted model of the AZT VIVACE fund followed the linear regression hypothesis regarding homoskedasticity.

9.3 Non-autocorrelation of random errors

To identify first-order autocorrelation, I will apply the Durbin – Watson Test.

The assumptions for the Durbin-Watson Test are:

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 10+ Student Version Lite generated for the AZT VIVACE fund in Table no. 5 Durbin-Watson statistics = 1.977293.

The critical values of the Durbin-Watson statistic for a significance threshold of 5% obtained for n = 10 and k = 1 are: dL = 0.88 and dU = 1.32.

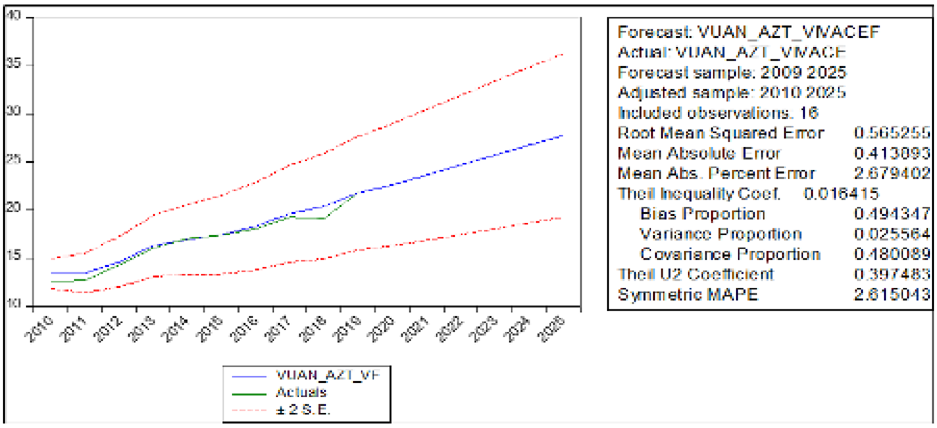
Since the calculated Durbin-Watson statistic is less than 4-dU = 2.68 and is greater than dL = 0.88, we can accept the null hypothesis that there is no autocorrelation of first order random errors in the case of the adjusted model associated with the AZT fund. VIVACE.

In conclusion, we can say that the adjusted model related to the AZT VIVACE fund observed the simple linear regression assumptions regarding the non-autocorrelation of first order random errors and can be used successfully for making forecasts.

10. Forecasts based on the estimated simple linear regression model

In this stage of econometric modeling, I will forecast VUAN for the privately managed pension fund AZT VIVACE for the period 2020-2025, given that the RRA, in the period 2020-2025, will be constant and will have a value of 4.5%.

Graph no. 5 Forecast of the unit value of the net assets of the AZT VIVACE fund for the period 2010-2025 (lei)



Source: Made by the author based on the data published on www.asfromania.ro, accessed on 14.03.2020

According to the forecast made by econometric modeling using EViews 10+ Student Version Lite, VUAN_AZT_VIVACE will reach the level of 27.8 lei at the end of 2025 (Chart no. 5). We can also say with a 95% probability that VUAN_AZT_VIVACE on December 31, 2025 will fall in the range [19.2; 36.3].

The result obtained by the forecast highlights the increasing trend for the values of the VUAN indicator for the entire forecast period (Chart no. 5). This confirms the logical assumption that a positive annualized rate of return leads to an increase in the unit value of the net assets of an optional pension fund provided that other influencing factors remain unchanged.

Following the processing of input data, using unifactorial linear regression, we obtained an econometric model with average creditworthiness for the fund under analysis, creditworthiness that manages to capture how the dynamics of the annualized rate of return influences the evolution of the net asset value.

The unifactorial model resulting from the estimation is:

$$\boldsymbol{D(VUAN\_AZT\_VIVACE) = 1,031910 + 10,75118 \times D(RRA\_AZT\_VIVACE)}$$

11. Conclusions

Following the estimation of the econometric model, we obtained the following final results:

- the determination coefficient confirms that the level of the annualized rate of return influences the increase of the unit value of the net asset, the value of this coefficient being 46.914%;
- there is a significant direct relationship between the unit values of net assets and those of annualized rates of return. We can say that a one-unit increase in the annualized rate of return for a fund entails an increase in the unit value of net assets by 10.75 monetary units.

I appreciate that the econometric model above is good for making predictions and can be improved by adding explanatory variables and transforming the unifactorial econometric model of linear regression into a multifactorial model.

12. Acknowledgement

This work was supported by the grant POCU380/6/13/123990, co-financed by the European Social Fund within the Sectorial Operational Program Human Capital 2014 – 2020.

13. References

- Andrei, T., 2008. *Introducere în econometrie utilizând Eviews.* Bucharest: Economica Publishing House
- Andrei, T. 2008. *Econometrie. Teorie și aplicații în Eviews și R,* Bucharest: Economica Publishing House
- Durac, C., 2018. Analysis of the Influence of the Anualized Rate of Rentability on the Unit Value of Net Assets of the Private Administred Pension Found NN. *Finance-Challenges of the Future*, 20, pp.175-188.
- The Financial Supervisory Authority, 2010, Norma nr. 7/2010 privind ratele de rentabilitate ale fondurilor de pensii administrate privat, *Official Monitor,* [online]. Available at: <https://asfromania.ro/files/pensii/NPII/N%20consolidata%207_2010%20privind%20ratele%20de%20rentabilitate.pdf> [Accessed 14 March 2020].