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A QUANTITATIVE APPROACH FOR THE FINANCIAL IMPROVEMENT OF PRIVATE PENSIONS SYSTEMS. ROMANIAN AND POLISH PERSPECTIVE

Abstract. *The multi-pillar system was described by the World Bank as a unique possibility in order to reach the core goal of social security: the provision of welfare for the retiree. Due to its mandatory character, the second pillar (privately administrated pension funds) has to underlie positive yields otherwise this system will seem to be a con. Many states underpin the necessity of a healthy market, based on minimum guaranteed efficiency.*

In this paper we are investigating the validity of the Romanian private pension market rules for the Polish market.

The present paper most important result is that the Romanian legislator had chosen a good model for the domestic market improvement, as long as we peak normal yields. We assert that the integrity of the Polish market as we enforced the domestic legal framework is a living proof of the fact that this model fits an emerging pension funds market.

Keywords: *private pension, Romania, Poland, logistic regression, market share.*

JEL Classification: G11, G23, C14

1. Introduction

Poland is the largest market of its kind in the region(see for example the analysis in Fultz, E., M. Ruck(2001*)*), setting an example for the Romanian market and private pensions while being a model of performance in Poland with funds from launch until now (May 2010) an average annual return of 5.83% over inflation (real return), despite the financial crisis last year.

Private pension system included at the end of 2004, ten million participants and 18 pension funds, and currently operates only 14 funds whose assets totaling currently (May 2010), EUR 46.02 billion (equivalent to PLN 191.7 billion). Apart from the fact that for last year was an increase of 26.8% in value in May 2009 was 36.5 billion additional private pension funds assets in Poland are the highest in the

region in terms the majority of assets are invested in Polish securities, only 2% of the investment can be found in other world countries. The Poles have achieved the best performance in Central and Eastern European states region in terms of yields obtained in the private pension system.

And relative growth in the Romanian pension fund assets of 10.68% was consistent, but in absolute values, the surplus is small, only 30.59 million euros, the data is calculated for a similar period, but Romania is in its infancy as it seeks ways to obtain the amounts promised by the rulers (the chart that was approved at the starting date of this multi-system), optimal placement.

In the first six years of implementing the system, pension funds have managed to double the amount of units, exceeding initial expectations of those who started pension reform in Poland in 1999. Polish success of private pension managers can explain the high level of investments in listed shares, 35.6% of such investment ceiling is 40%, most managers betting the maximum. Regarding the net replacement rate of individual income, for income up to 50% of the average wage is 86.6% for incomes up to 100% of the average wage is 90.5% and for the up to 200% of the average wage is 92.6%.

One of the problems facing Poland in the first year of the private pension system was due to IT system was not ready in time so that after the first year in one of five accounts of taxpayers Polish zloty was not true of any, they should them three years to tackle problems of unfair distribution of money between various state institutions.

Even if there were problems in implementing the system, pension reform in Poland was a success and had the main effect of encouraging strong capital markets in this country.

The data show a clear trend of sustained growth, net assets reaching the end of May to the historical maximum of over 147 billion zlotys. The funds also had an average annual return of 24.3% (May 2009-aprilie2010). Top results from origin of April lies substantially improve the situation Warsaw Stock Exchange, whose main index WIG20 (Warsaw Stock Exchange index) registered a monthly increase of almost 19%, highest since January 2002 until now.

Quantitative methods for insurance market are well-know and applied on a large scale. For example, in Dragotă, M., Serbanescu, C., Pele, D.T.(2008), is developed a model explaining the determinants of market share in Romanian insurance market using Shannon entropy and Principal Component Analysis. There are mainly two objective functions to analyze on such a market: risk and return. The problem of risk has been widely analyzed (the approach in Mircea, I, Covrig, M.,Cechin-Crista, D.(2009) is a good theoretical point), even the problem is not at his end. The regulations are changing constantly as a result of financial crisis and the markets should adopt appropriate models for risk management.

The return problem on insurance market can be related to classical approach of portfolio selection, obtaining an equilibrium between risk and return (see for example the approach in Fulga, C., Dedu, S., Serban, F.(2009)).

2. Data and methodology

The case study delves if the actual Romanian legislation is accurate by applying the methodology to a well-known market (the elder and most efficient): the Polish one.

In order to asses this goal, we have used monthly data from Polish insurance market, covering the time interval 2002-2009.

Our sample contains 19 companies from the Polish insurance market, but not all the companies have data available for the entire time horizon.

Table 1. Sample used in the analysis.

Company	Number of monthly observations	Average Monthly Return
AEGON OFE	88	0.679%
AIG OFE	88	0.745%
AXA OFE	46	1.510%
Allianz Polska OFE	51	0.505%
Aviva OFE Aviva BZ WBK	88	0.642%
Bankowy OFE	88	0.671%
Credit Suisse Life & Pensions OFE	42	0.912%
Generali OFE	75	0.737%
ING OFE	88	0.719%
Nordea OFE	88	0.666%
OFE Allianz Polska	37	0.839%
OFE Kredyt Banku	32	0.816%
OFE PZU	88	0.708%
OFE Pocztylion	88	0.692%
OFE Polsat	88	0.771%
OFE Skarbiec-Emerytura	79	0.632%
OFE VARTA	88	0.686%
Pekao OFE	88	0.709%
Zurich OFE	13	0.667%

Source of data: www.zus.pl

According to Romanian insurance legislation[1], there is a specific methodology used for the surveillance of the insurance companies, taking into account criteria related to risk and return.

We will define the following indicators:

- A_t represents the accounting unit value for time t;
- $r_T = \sum_{t=T-23}^{T} (\ln A_t - \ln A_{t-1})$ represents the multiperiod return index, computed from accounting unit value on a rolling window of 24 months;
- General market return r_T^{market} was computed as a weighed average of individual returns of the companies, where the weights are computed according to Net Asset Value. As the individual returns are computed on a rolling window of 24 months, also the market return will be computed using a 24 months rolling window.

According to Romanian law, if a company has a return lower than the limit defined as $L_T = \min(r_T^{market} - 0.04, 0.5 * r_T^{market})$ and this situation stands for 12 consecutive months, then that company will be suspended from the market.

2.1. Binary logistic regression approach for probability of failure

Applying this methodology for Polish data, we couldn't find any company having return lower than the return limit for 12 consecutive months. Yet, we have identified several companies with near limit behaviour:
-AVIVA OFE – was under limit for 7 months(january-july 2009)
- OFE POLSAT – was under limit for 11 months(october 2008-july 2009)
- PEKAO OFE - was under limit for 6 months(february-july 2009)

As a consequence of market stability (all the funds still remain in the market), the next goal was the analysis of the factors generating the previous result.

We asumed a Bernoulli distribution for default variable $Y: \begin{pmatrix} 0 & 1 \\ 1-\pi & \pi \end{pmatrix}$, where $Prob(Y = 1) = \pi$ is the probability of being eliminated from the market, according the the rule above.

A binary logistic regressionmodel(following the methodology from [7]) was estimated :

$ln\frac{\pi}{1-\pi} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$, where:

-X_1 is the average Interests amount (in ZL) for the Pension Contributions Transferred to Open Pension Funds by ZUS for the past 24 months;

-X_2 is the average number of contributors of the fund in the past 24 months;

-X_3 represents the average Pension Contributions Transferred to Open Pension Funds by ZUS in the past 24 months.

[1] Standard no. 7/2010, published in Official Gazette, part I, no. 369, june 4th 2010: www.csspp.ro.

Since we are estimating a logistic regression, the approach differs from the classical linear regression model.

Actually, the parameters are estimated using the maximum likelihood method(ML). Let $Y:\begin{pmatrix} 0 & 1 \\ 1-\pi & \pi \end{pmatrix}$ the default variable such as $\Pr(Y=1)=\pi$ and $\Pr(Y=0)=1-\pi$.

In fact, we are dealing with $y_1,...,y_n$, the observed values in the analyzed sample. Then the likelihood function is $l(\beta)=\prod_{i=1}^{n}\pi_i^{y_i}(1-\pi_i)^{1-y_i}$ and the log-likelihood function has the expression

$$L(\beta)=\ln l(\beta)=\sum_{i=1}^{n}[y_i\ln\pi_i+(1-y_i)\ln(1-\pi_i)].$$

The parameters of the logistic model are estimated by imposing the minimum condition to log-likelihood function: $\frac{\partial L(\beta)}{\partial\beta}=0$.

In fact, in the logistic regression model we are concerned with the odds ratio estimates.

Rewriting the logistic model, we have:

$\frac{\pi}{1-\pi}=\exp(\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3)=\exp(X\beta)$, where

$X=(1\ X_1\ X_2\ X_3)$ and $\beta'=(\beta_0\ \beta_1\ \beta_2\ \beta_3)$.

The Odds Ratio corresponding to variable X_1, for example, is defined as the ratio $OR=\dfrac{\left(\frac{\pi}{1-\pi}\mid X=(1\ x_1+1\ x_2\ x_3)\right)}{\left(\frac{\pi}{1-\pi}\mid X=(1\ x_1\ x_2\ x_3)\right)}=\exp(\beta_1)$.

The Odds Ratio can be interpreted as the change of odds as a result of unit change of explanatory variable.

Table 2. Odds Ratios Estimates for Binary Logistic Regression

Variable	Point Estimate	P-value	Percent Concordant	86.4	Somers' D	0.743
X1	1.02	<0.05	Percent Discordant	12.1	Gamma	0.755
X2	0.98	<0.05	Percent Tied	1.6	Tau-a	0.021
X3	1.078	<0.05	Pairs	13244	c	0.872

Source: Authors'computations based on SAS software

Some interesting conclusions can be obtained from the analysis of the Odds Ratios.

For example, if X1 increases by 1 unit, the chances to deal with a return below the withdraw limit draw by 2%.

This can be explained by the fact that the contribution rate increase would directly affect the efficiency of pension fund, in that its obligations would increase, so yield is likely to decrease, even below the market average.

It should be interpreted with caution because there may be cases, such as AEGON OFE, where decrease interest amount average was correlated with a continuous decrease in pension fund returns 28.63% in July 2007-24, 51% in May 2009.

Another important independent variable is the average number of participants. In this interpretation may be the following manner: an increase of 100 persons in the average number of participants stated above chances decreases to 0.46%, i.e. increasing the portfolio is a key risk mitigation.

However, this observation must take into account and fund management as well as possible mergers and acquisitions that result to be relevant for further analysis.

The most important factor explaining the dependent variable appears to be paid from state contributions to private pension fund administrators. Thus a one unit increase in the amounts paid, likely to be below market yield increases by 7.84%, a surprising result considering the size of the market.

The results of the chi-square test and of the Wald test show that the coefficients of the model are statistically significant. Moreover, the nonparametric correlation coefficients show that the classification ability of the model is fair enough.

Thus, the Summer's correlation coefficient is 0.74, indicating a good discriminating power.

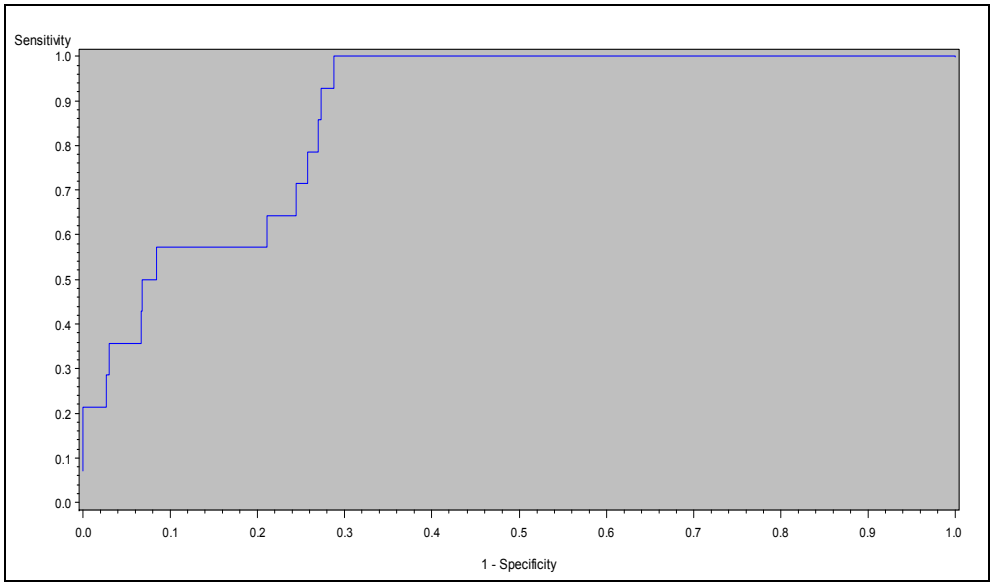

Figure 1. ROC Curve

A good overview about the efficiency of the model can be obtained using the ROC curve, which is a made by plotting sensitivity of the model against 1-specificity.

The area under the ROC curve can be seen as the probability of the following event: if we choosing by random one positive and one negative case, the estimated probability for the positive case is higher than the estimated probability of the negative case. For our model the area under the ROC curve is 87.2%, meaning a very good predictive power.

The present paper most important result is that the Romanian legislator had chosen a good model for the domestic market improvement, as long as we peak normal yields. We assert that the integrity of the Polish market as we enforced the domestic legal framework is a living proof of the fact that this model fits an emerging pension funds market.

2.2. Factors influencing market share of insurance companies

Additionally, for the case study we chose to create a model to highlight the extent to which the share of portfolio investment is influenced at certain level of existing companies in the Polish market, the time horizon considered is January 2007 - November 2009, because up to this we had homogenous data for all funds under consideration.

The dependent variable is the share of NPV, i.e. the share net asset value determined as the ratio between net asset value for each company in the Polish market profile, for each month separately.

Number of observations was 367, representing data that could be collected in the database KNF (Polish Financial Committee), the entity that manages both the insurance market and private pensions market.

Independent variables of the model we want to estimate are also the weights of each element of the 14 private pension funds have chosen to select and present the following manner (although not mentioned in the individual variables we assume that is known to speak strictly of weights):

X1 – bonds and treasury bills;

X2 - Debt securities guaranteed or backed by the State Treasury or the National Bank of Poland;

X3 - Deposits, bank securities;

X4 - Shares listed on a stock exchange;

X5 - Shares listed on a regulated over-the-counter market, dematerialized;

X6 - Shares of National Investment Funds;

X7 - Investments certificates of investment funds;

X8 - Non-treasury dematerialized debt securities;

X9 - Income Bonds;

X10 - Non-treasury dematerialized debt securities fully secured;

X11 - Non-treasury debt securities fully secured not dematerialized;

X12 - Other debt securities of public companies;

X13 - Mortgage bonds;

X14 - Bonds issued BGK;

X15 - Other foreign securities.

The final model has the following form:

$$\hat{Y} = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_5 X5 + \beta_6 X6 + \beta_7 X7 + \beta_9 X9 + \beta_{12} X12 .$$

Table 3. Analysis of Variance for the regression model

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.94821	0.13546	35.31	<.0001
Error	359	1.37737	0.00384		
Corrected Total	366	2.32558			

Source: Authors'computatations based on SAS software

The R-square value indicates that 40.77% of the variation in the dependent variable is explained in terms of changes in explicative variables (investments in certain assets).

Table 4. Performance Indicators

Root MSE	0.06194	**R-Square**	0.4077
Dependent Mean	0.06551	**Adj R-Sq**	0.3962
Coeff Var	94.54864		

Source: Authors'computatations based on SAS software

We will further analyze the results for each of the variables X1 ... X15 who remained in the analysis. We say this because the analysis remained only seven variables, X1, X2, X5, X6, X7, X9, X12.

Variables are uncorrelated because the model was estimated using a stepwise method, which finally allows us to keep in the model only the significant and uncorrelated variables.

Tabel 5. Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.07562	0.03635	-2.08	0.0382
X1	1	0.30998	0.05499	5.64	<.0001
X2	1	-12.32779	1.47305	-8.37	<.0001
X5	1	-14.53398	4.51012	-3.22	0.0014
X6	1	11.33742	1.69621	6.68	<.0001
X7	1	-10.18802	1.12660	-9.04	<.0001
X9	1	13.18648	3.35364	3.93	0.0001
X12	1	-2.02805	0.21710	-9.34	<.0001

Source: Authors'computatations based on SAS software

We will analyze the coefficients of the explicative variables kept in the model.

- X1: Bonds and treasury bills

Regarding economic interpretation, the above coefficient is 0.30998. This relationship means that a 1% change in the share of government securities (variable X1) at a given level of market manager, at a time (one of the months considered in the analysis), determine the share of the asset manager that the total market portfolio of approximately 0.3% variation.

In other words, if it is to talk about market share to a director with the benchmark value of its assets in the total market assets, an increase of 0.3% of the shares may be obtained through the increase of investments in that fund

government bonds and similar instruments by 1% compared with the existing value in the previous month.

Here we think we need more comprehensive thinking because this development is likely to be explained entirely by the decision of participants who wish to protect themselves from risks associated with various actions and corporate bonds to focus the fund, which according to investment decision have a lower associated risk.

-X2: Debt instruments guaranteed by the Treasury or the NBP

The coefficient of this variable is -12.38%. As will be further noted that it is an element that pension funds' managers should avoid it, depending on what they regard as compared with the indicator of market share.

This figure reveals an element that administrators should not insist, as this influence the following manner: an increase of the debt instruments guaranteed by the Treasury or National Bank of Poland by 1% generates a reduction of over 12% share market fund assets relative to test market fund total assets.

-X5: Action listed on a regulated OTC market, dematerialized

This is the second item on which managers should think about before being placed, as most managers would lose market share in value relative to each increase of investments in shares listed.

- X6: Actions of the NIF (National Investment Funds) and X9: Income Bonds

Income Bonds are debt instruments to which only the amount that is secured creditor coupon is awarded only to the issuer subject to the existence of sufficient funds to enable this payment .Regarding economic interpretation, the above indicator is 11.33 for X6 and 13.38 for X7. These are elements that should be pursued by the pension fund in order to optimize the placement of additional market share.

3. Conclusions

In this paper we have investigated the validity of the Romanian insurance market rules, applying to the Polish market**.**

The present paper most important result is that the Romanian legislator had chosen a good model for the domestic market improvement, as long as we peak normal yields.

We assert that the integrity of the Polish market as we enforced the domestic legal framework is a living proof of the fact that this model fits an emerging pension funds market.

Moreover, analyzing the factors who determined the market share of insurance companies, one can conclude that the investments in shares of the NIF (National Investment Funds) and income bonds are elements that generate positive developments in terms of market share, so the outlook for future investment policy to managers on optimizing investments should consider these two elements.

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