ANALYSIS OF THE RETURNS AND VOLATILITY OF THE ENVIRONMENTAL STOCK LEADERS

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Abstract: *The last years have been faced with a blasting development of the Socially Responsible Investments (SRI) worldwide even though the economic environment has been shaken by a global economic and financial crisis. The aim of this paper is to analyze the return and risk characteristics of the sustainably managed companies that pay particular attention to the environment responsibility in comparison with those that pay more attention to the corporate governance and respectively to the social responsibility. These characteristics are useful both to the individual and institutional investors as well as to the portfolio managers. For the comparative analysis we started from the study of descriptive characteristics of return and risk of indices portfolios of the environmental social and governance stock leaders and we focused on their univariate econometric modelling by means of the heteroskedastic models. The studies undertaken until now are centered on the performance obtained by the portfolios of sustainable indices and on the modelling of the volatility of sustainable indices. We would like to investigate the characteristics of return and risk of the assets of the sustainably managed companies that could attract active investors towards the sustainably managed companies that pay particular attention to the environment responsibility in comparison with those paying increased attention to the corporate governance and respectively to the social responsibility.*

Keywords: financial market; risk; return; heteroskedastic models.
JEL Classification: G15, C58.

INTRODUCTION

The birth of the modern portfolio theory with Markowitz's paper (Markowitz, 1959) underlined the importance of the profit obtained and the risk taken when holding an asset portfolio. The analysis of the last years highlights that the stakeholders of a company are not only interested in the profit obtained but also in the effects of the company on environment and social life. This new business model is known as Corporate Social Responsibility (CSR), while the investments performed in the assets of these companies are called Socially Responsible Investment (SRI), ethical investment or sustainable investment (Renneboog, 2008).

The evolution of total SRI assets under management in Europe is remarkable: on December 31, 2007, there were 2.665 trillion Euros while on December 31, 2009 there were 5 trillion Euros (EUROSIF 2008, 2010). It was natural that within this interest framework, funds of financial assets should appear being able to buy and manage stocks of the sustainably managed companies.

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Since the Socially Responsible Investment grew in importance, indices were created to reflect the evolution of the companies managed in such a business manner. The SRI indices created offer the investors who want to build the portfolio of financial assets selected by means of the sustainability criterion, a benchmark portfolio. The number of SRI indices burst after 2006 so that in June 2011 there was 116 SRI indices worldwide out, of which 32 underline the environmental topic (Sun et al., 2011). The selection criteria of the companies which are included in the indices portfolios are different but all of them refer to corporate governance, environment responsibility and social responsibility.

The studies undertaken so far which take into consideration the SRI indices focus especially on the performance adjusted through risk and obtained by means of the SRI indices portfolios in comparison with the portfolios of the general stock indices (Schroder, 2003), (Di Bartolomeo, Kurtz, 1999). Some of these studies draw the conclusion that the performance of sustainable indices portfolios comparatively with the performance of their benchmark indices is higher (Di Bartolomeo, Kurtz, 1999), or a little bit smaller (Schroder, 2003).

Hoti et al. (Hoti et al., 2005) focus on modelling the environmental risk and analyze the portfolios of indices DJSI World, DJSI STOXX and DJSI EURO STOXX in comparison with the portfolios of indices DJIA and S&P500. The results obtained confirm that there are differences in the return and volatility behaviour between the portfolios of sustainable indices and the portfolios of general stock exchange indices.

Now, when a great part of the assets of the companies holding CSR management and which consequently take into account within their management strategy the elements related to corporate governance, environment responsibility and social responsibility, it is time to ask whether there are significant differences from the point of view of return and risk between the stocks of those companies putting on the first place the environment responsibility, the social responsibility or the corporate governance. Our study is facilitated by the existence of the three Global ESG Leaders Indices: STOXX Global ESG Environmental Leaders, STOXX Global ESG Social Leaders, STOXX Global ESG Governance Leaders, calculated based on the prices of the previously mentioned stocks.

This paper has several goals. These focus on the comparative analysis of the implications of the descriptive characteristics of return and risk of the environmental, social and governance stock leaders; the comparison of statistical and econometric characteristics of return of the environmental, social and governance stock leaders and their implications; the modelling of return and risk of the environmental, social and governance stock leaders and the identification of the best evolution models; the implications of the chosen model on the investors' choice; the evaluation of the possibility to anticipate on the basis of the indices of sustainably managed stocks the business cycles in the Euro zone and in the USA.

In order to reach these objectives we use a wide and diverse range of statistical and econometric methods prevalently used by the financial statistics and econometrics as well as by the business cycle econometrics.

1. CASE-STUDIES PRESENTATION

Dow Jones Indexes, STOXX Limited and SAM (Sustainable Asset Management, Switzerland) have begun to publish since 1999 the first global indices reflecting the general trend of the sustainably managed companies. These are the first SRI indices. In March 2010 the indices previously determined lose the prefix DJ (from Dow Jones) after Dow Jones & Company exits the joint venture because Deutsche Börse AG and SIX Group AG become sole shareholders of STOXX. Now STOXX offers two families of sustainable indices: STOXX ESG Leaders indices and STOXX Sustainability indices.

Within the family STOXX ESG Leaders indices Sustainalytics, a leading global provider of ESG research and analysis, key performance indicators (KPIs) for three sub-areas of stocks are determined: environmental (ENV), social (SOC) and governance (GOV). Taking into consideration these indicators the stocks are selected and three indices of the shares of the environmental, social and governance stock leaders are calculated. These are: STOXX Global ESG Environmental Leaders, STOXX Global ESG Social Leaders, STOXX Global ESG Governance Leaders. In order to reach the objectives already presented in the paper, we shall analyze the return and risk of the index portfolio of environmental stock leaders in comparison with the portfolios of indices of the social and governance stock leaders.

The daily values of the indices analyzed are taken from the website www.stoxx.com. We have at our disposal the values of the indices from 21 September 2001 (the moment when these indices began to be calculated) until 12 of July 2012. The values of the indices have been noted with PENV, PSOC and respectively PGOV, while the daily returns of the indices portfolios have been noted with LRENV, LRSOC and respectively LRGOV.

The return of a stock portfolio is determined according to the relation:

$$r_t = (lnP_t - lnP_{t-1}) * 100$$

where: r_t - the continuously compounded return

P_t, P_{t-1} - the price of a portfolio at the moment t, t-1 respectively

The returns of portfolios of the three indices under analysis will be noted with LRENV, LRSOC and LRGOV.

The total risk of a stock portfolio can be measured by means of variance or standard deviation. When the returns of the portfolio are stationary the variance and the standard deviation of the portfolio returns are calculated as follows:

$$\sigma^2 = \frac{1}{T}\sum_{t=1}^{T}(R_t - \bar{R})^2, \quad \sigma = \sqrt{\frac{1}{T}\sum_{t=1}^{T} (R_t - \bar{R})}$$

where: σ^2, σ - the variance or respectively the standard deviation of the portfolio returns during the sub-period (t-1, t);

R_t - the portfolio return during the sub-period (t-1, t);

$\bar{R}$ - the average of the portfolio returns for the entire period;

T - the number of sub-periods.

The variance determined by means of the previous formula is also called unconditional variance and it is supposed to be constant throughout the entire period under analysis. Since the variance of the portfolio returns is not constant during the entire analyzed period, when analyzing the risk an important role is played by the conditional variance which changes anytime because it depends on the history of returns until the moment it is calculated. The conditional variance will be presented in the modelling of the volatility of indices portfolios.

1.1. The descriptive statistical analysis of return and risk

Within this framework we shall analyze the distribution of the return of the portfolio index of environmental stock leaders in comparison with the distributions of indices portfolios of social and governance stock leaders. The previous studies show that the financial variables are characterized by an excess of leptokurtosis also known as “fat tails” (Mandelbrot, 1963) that is why the distributions of returns do not follow a normal distribution law. To test the normality of distributions we shall use the Jarque-Bera test which is calculated in relation to the asymmetry and kurtosis indicators.

The graphical representation of returns of the indices portfolios shows that if the conditional variance is constant in time and if it is presented in clusters it is known under the name volatility clustering. Volatility clustering refers to returns in which high variations are followed by high variations and low variations are followed by low variations. This characteristic reveals that a shock (a new piece of information, for example) on the stock market has an influence that persists over time and may be empirically tested by means of returns' dependence.

1.2. The econometric analysis of return and risk

In the econometric analysis we focus in the first stage on the stationarity of the variables under analysis. The testing of returns' stationarity is a necessary analysis before their modelling. The stationarity property is very important in the econometric analysis from the following reasons (Berdot, J.-P., 2003):

-the traditional statistical inference has a meaning only for the stationary variables. By definition it is impossible to estimate a moment (mean or the variance) of a time series when this moment varies in time. The estimation of the moment in t starting from a single available value performed in t would not have any sense;

-the search for a relationship between two non-stationary variables is impossible: the regressions generally become spurious and cover only the existence of artificial, common trends, without real significance;

-the forecast often becomes hazardous for the non-stationary variables when the variables follow random behaviours.

In order to test the stationarity of variables we shall use the Augmented Dickey-Fuller test. The null hypothesis of this test implies that the analyzed variables have a unit root, meaning they are not stationary while the alternative hypothesis implies that the returns are stationary.

During the second stage we test the returns' autocorrelation. The Ljung-Box test allows reaching two goals (Berdot, J.-P., 2003): it enables the precision of the character of the process followed by the returns' rates (AR – autoregressive, MA – mobile mean or ARMA autoregressive and mobile mean) and it determines whether the returns' rates are correlated or not, this last hypothesis being frequently met in the theoretical or empirical literature of financial markets.

During the third stage, we test the autocorrelation of the returns' squares. The Ljung-Box test will reveal if the returns are dependent. The dependence means the situation when the high return rates (positive or negative) are followed by other extreme return rates, no matter what their sign (Berdot, J.-P., 2003). The presence of the dependence of return rates suggest that they can be modeled by means of the ARCH (Auto Regressive Conditional Heteroskedasticity) autoregressive conditional models.

Then we modeled return and risk of the portfolios. The autoregressive conditional models are comprised of two equations: the equation of the conditional mean and the equation of conditional volatility. The equation of conditional mean is generally an ARMA model but in this equation other influence factors of return can be introduced (for instance macroeconomic variables). The equation of conditional volatility will be specified for each and every model in what follows.

The GARCH model (Generalized Autoregressive Conditional Heteroskedasticity) was created by Bollerslev (Bollerslev T., 1986) and represents a generalization of the ARCH model created by Engle (Engle, R.F., 1982). For the ARCH model Engle received the Nobel Prize in 2003. By means of this model, two characteristics are taken into account: a characteristic of volatility, volatility clustering, and a characteristic of return, fat tails.

The GARCH(p,q) model is presented in the following form:

$$h_t=\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\varepsilon_{t-2}^2 + \cdots + \alpha_p\varepsilon_{t-p}^2+\beta_1 h_{t-1}+\ldots+\beta_q h_{t-q}$$

The following conditions must be met in order for volatility h_t to be positive:

$\alpha_0 > 0, \alpha_i \geq 0, \beta_i \geq 0$. At the same time, the stationarity condition is ensured if $\alpha_i+ \beta_i < 1$.

The GARCH-M (GARCH in Mean) model offers a new possibility which is pertinent to the extent to which the financial markets remunerate risk: these models assume that the risk level (positively) influences the expectancy of return. This assumption allows the conditional expectancy of the variance (or the standard conditional deviation) to be taken into account as an explanatory variable.

The GARCH(p,q)-M(1) model may be written as follows:

- The model ARMA(p,q) for Y: $Y_t = a_0 + a_1 Y_{t-1}+\ldots+a_p Y_{t-p}+m_1\varepsilon_{t-1} + m_q\varepsilon_{t-q} + a_1'\sqrt{h}$

$$h_t=\alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\varepsilon_{t-2}^2 + \cdots + \alpha_p\varepsilon_{t-p}^2+\beta_1 h_{t-1}+\ldots+\beta_q h_{t-q}$$

The following conditions must be met in order for volatility h_t to be positive: $\alpha_0 > 0, \alpha_i \geq 0, \beta_i \geq 0$ and $\alpha_i+ \beta_i < 1$.

This model allows us to study the relationship between risk and the expected return. In the first equation $a_1'\sqrt{h}$ represents the reward for taking the risk. The estimator for parameter a_1' is significant if volatility has an influence on the value of the return. Parameter $\acute{a}_1$ is interpreted as follows: if $\acute{a}_1 > 0$ for taking a high level of risk the investors are rewarded with high returns, if $\acute{a}_1 < 0$ the investors are penalized for taking the risk.

The following models, EGARCH, TGARCH and APGARCH take into consideration the asymmetry phenomenon of the impact: a new, negative piece of information (a shock) of the same force as a positive piece of information determines a higher volatility. For each of these asymmetric models we shall also study the "average" lot variant (EGARCH-M, TGARCH-M and APGARCH-M) in order to study the relationship between return and risk.

By means of the EGARCH model (exponential GARCH) (Nelson, D. B., 1991) the asymmetry phenomenon of the impact of news on returns is modeled: a negative shock with the same force as a positive shock leads to a higher increase of volatility (asymmetric volatility).

The EGARCH(1,1) model has the following formulation:

- The model ARMA(p,q) for Y: $Y_t = a_0 + a_1 Y_{t-1} + \ldots + a_p Y_{t-p} + m_1 \varepsilon_{t-1} + m_q \varepsilon_{t-q}$

$$lnh_t = \alpha_0 + \alpha_1 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \gamma_1 \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \delta_0 lnh_{t-1}$$

The asymmetry effect is highlighted by γ_1. This estimated parameter must be significant and lower than zero.

The EGARCH –M model also takes into consideration in the modelling the relationship between the assumed risk by investors and the expected return, apart from the asymmetry phenomenon of volatility. In comparison with the EGARCH model previously presented in the mean equation there will also be the variance, the standard or logarithm deviation within the conditional variance.

The TGARCH model occurs from the need to take into consideration when modelling the return and risk of the leverage phenomenon. (Glosten, Jagannathan and Runkle (1993) and Zakoian (1994)).

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \gamma_1 \varepsilon_{t-1}^2 d_{t-1} + \beta_1 h_{t-1}$$

The asymmetry effect is highlighted by γ_1. This estimated parameter must be significant and bigger than zero.

The APGARCH model is proposed by Ding et al. (Ding et al., 1993) following the identification of returns' autocorrelation within the mode for long lags.

The conditional variance for a APGARCH(1,1,1) is modeled by the equation:

$$h_t^{\delta} = \alpha_0 + \alpha_1 (|\varepsilon_{t-1}| - \gamma_1 \varepsilon_{t-1})^{\delta} + \beta_1 h_{t-1}^{\delta}$$

The recorded parameters must meet the following requirements $\delta \geq 0$, $\alpha_0 > 0$, $\alpha_1 \geq 0$, $\beta_1 \geq 0$ and $|\gamma_1| \leq 1$. If $\gamma_1 \neq 0$, the conditional volatility is asymmetric.

For the estimation of conditional volatility Engle (Engle, R.F., 1983) used the normal distribution. Since the distribution of the residual variable resulted from modelling did not follow a normal distribution law due to an excessive leptokurtosis, in 1987 Bollerslev (Bollerslev T., 1987) proposed the standardized Student t distribution while in 1991 Nelson (Nelson, 1991) proposed Generalized Error Distribution (GED).

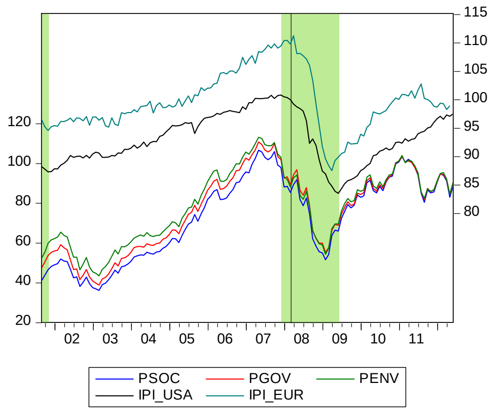
Once the heteroskedastic models have been estimated, we tested specific regression model estimation assumptions. Then, we chose the best model depending on Adjusted R squared and the Akaike, Schwarz, Hannan-Quinn information criteria.

2. RESULTS AND DISCUSSION

2.1. The descriptive statistical analysis of return and risk

In figure 1 we presented the time evolution of the indices portfolios of the environmental, social and governance stock leaders (having as a standard the left vertical axis) and the evolution of the industrial production indices in the USA and the Euro area (17 European countries). The shadowed areas represent periods of economic downturn in the USA for the period under study (according to the National Bureau of Economic Research). During the time span analyzed (21 September 2001 – 12 July 2012) the Euro area is subject to a period of economic recession (according to the Euro Area Business Cycle Dating Committee) that starts later than that in the USA marked by the vertical line. The graph shows that the evolution of the three indices portfolios is almost parallel until the moment when the recession in the USA starts, after which the evolutions of the indices portfolios almost coincide (situation which is visible only in the middle of the year 2010). As a consequence, as regards the evolution of the index portfolio of the environmental stock leaders from the graphical representation, this does not differ much from the evolution of the indices portfolios of social and governance stock leaders.

Figure 1 - The evolution of the indices of the stocks of environmental, social and governance stock leaders and GDP for the USA and Europe during 21 September 2001 - 12 July 2012



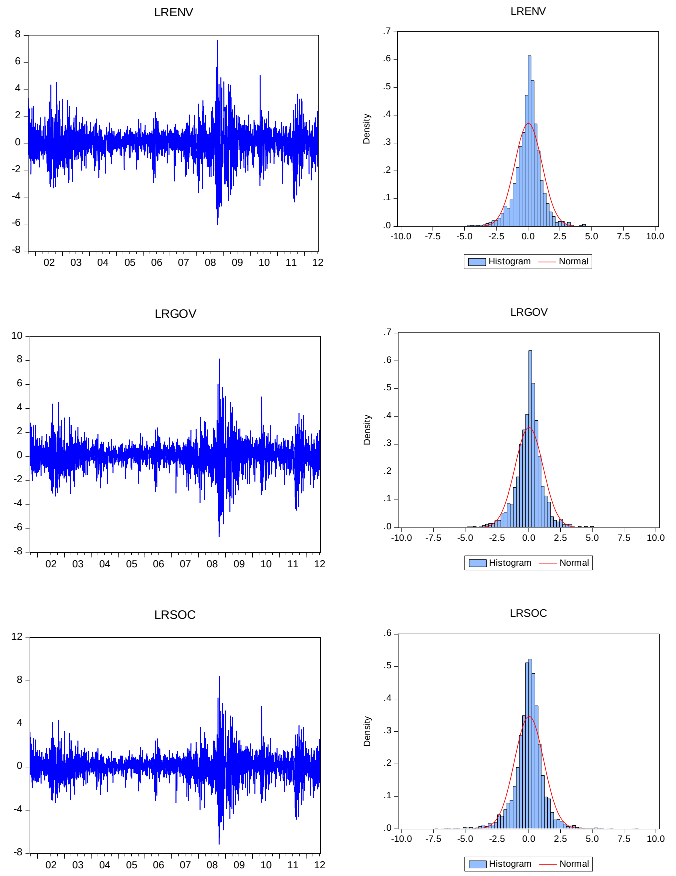
In the figure above we have the time evolution of the daily returns of the indices portfolios of the environmental, social and governance stock leaders as well as the distribution of these returns presented alongside a normal distribution of the same mean and dispersion. Therefore, we may draw the following conclusions:

- the returns of the indices portfolios present a cluster variation: the low variations are followed by low variations regardless of their sign while the high variations are followed by high variations. The cluster variation of the volatility of returns of the indices portfolios suggest the returns' dependence and can be numerically tested by means of the Ljung-Box test applied to the return's squares. We also notice that during the periods of economic downturn the variation is higher in comparison with the periods of economic growth;

- the distributions of the daily returns of the indices portfolios are leptokurtic which means that the frequencies for the returns' distributions are higher than those of the normal distributions. This feature is also known as "fat tails";

- due to the strong leptokurtic nature of the returns' distributions, these may not follow a normal distribution law. Therefore, it suggests to the investors that the investment in these portfolios may determine either to get high profits, or high losses, higher than the normal ones. We can test the normality of returns' distributions using the Jarque-Bera test.

Figure 2 - The returns and the distribution of returns of the stocks of environmental, social and governance stock leaders during 21 September 2001 - 12 July 2012



On account of the graphical assessments performed on the daily returns of indices portfolios of the environmental, social and governance stock leaders and the distribution of these returns, presented alongside a normal distribution of the same mean and dispersion, we may say that the returns of the index portfolio of the environmental stock leaders do not have significantly different features in comparison with the returns of the indices portfolios of social and governance stock leaders.

Before estimating the descriptive statistics of portfolios' returns we tested their stationarity. We used the Augmented Dickey-Fuller test. The null hypothesis supposes that the variable has a unit root (it is not stationary). The probabilities associated to the ADF tests performed for the three tested models are lower than the risk taken during the testing (5%), which shows that the returns of the indices portfolios are stationary. Since the values of the two information criteria Akaike and Schwarz are minimal for the model without intercept and trend, this proves that the average daily returns of the three portfolios are not significantly different from zero.

The analysis of descriptive statistics shows that the distribution of returns of environmental stock leaders is characterized by the lowest average return as well as by the lowest total risk (measured by means of the standard deviation). As a consequence, this situation suggests a relationship between risk and return. The risk-averse investors will prefer to choose the portfolio of the environmental stock leaders against the other ones because they present a higher risk. As it was also natural, the extreme minimal and maximal values are lower for the portfolio of environmental stock leaders.

Table 2 - The estimation of descriptive statistics of the index portfolio returns of the environmental, social and governance stock leaders

		LRENVD	LRGOVD	LRSOCD
Mean		*0.021674*	0.024850	0.029619
Median		0.066684	0.077582	0.077598
Maximum		7.651096	8.132840	8.405904
Minimum		-6.067941	-6.735958	-7.175965
Std. Dev.		*1.075904*	1.106854	**1.150459**
Skewness		-0.184066	-0.230854	-0.231452
Kurtosis		7.449098	8.173993	8.295923
Jarque-Bera		2340.113	3168.298	3318.322
Probability		0.000000	0.000000	0.000000
Observations		2818	2818	2818

The results are obtained by means of the Eviews statistical software.

The kurtosis indicator confirms what we had already observed from the graphical representation of returns' distribution: the leptokurtosis. On the basis of these numerical indicators we can ascertain that the leptokurtosis of the distribution of the portfolio index of environmental stock leaders is less excessive, indicating once again that when possessing it the losses are lower than in the case of the other two portfolios. The daily return rates of the portfolio environmental stock leaders present a smaller left asymmetry than that of the other two portfolios. The distribution of the daily return rates of the portfolios is displayed towards the negative values of the distribution.

The null hypothesis of the Jarque-Bera test supposes that the tested distribution follows a normal distribution law. According to the results in table 2 the probabilities associated with this test are lower than the risk taken during testing of 5%. Therefore, with a 95% probability we can ascertain that the distributions of portfolio returns do not follow a normal distribution law.

Table 3 - The estimation of the coefficients of bivariate correlation among the returns of the index portfolios

Correlation			
	LRENV	LRGOV	LRSOC
LRENVD	1.000000		
Probability			
LRGOVD	0.988062	1.000000	
Probability	0.0000		
LRSOCD	0.985005	0.993346	1.000000
Probability	0.0000	0.0000	-

The results are obtained by means of the Eviews statistical software.

The estimated coefficients of bivariate correlation among the returns of the three portfolios under analysis show that there is a very strong direct correlation.

2.2.The econometric analysis of return and volatility

In what follows we aimed at studying the autocorrelation of the returns of index portfolios. The statistical test which was used is the Ljung-Box test. The null hypothesis associated with the test implies that the returns of the three portfolios are autocorrelated. This result proves that the portfolio returns can be forecasted based on the previous values. The possibility to forecast the three portfolios suggests that the market of sustainably managed stocks is not efficient from an information point of view in a weak sense.

Table 4 - Testing the autocorrelation of the returns of index portfolios of environmental, social and governance stock leaders

LRENVD				LRGOVD				LRSOCD			
AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
0.131	0.131	48.358	0.000	0.103	0.103	29.816	0.000	0.095	0.095	25.517	0.000
-0.032	-0.050	51.167	0.000	-0.023	-0.034	31.363	0.000	-0.028	-0.037	27.717	0.000
-0.026	-0.015	53.060	0.000	-0.028	-0.022	33.520	0.000	-0.027	-0.021	29.763	0.000
0.027	0.032	55.114	0.000	0.035	0.040	36.959	0.000	0.035	0.039	33.207	0.000
-0.029	-0.039	57.487	0.000	-0.044	-0.054	42.463	0.000	-0.044	-0.054	38.723	0.000
-0.049	-0.039	64.400	0.000	-0.051	-0.040	49.918	0.000	-0.049	-0.038	45.396	0.000
0.012	0.024	64.819	0.000	0.019	0.029	50.938	0.000	0.017	0.025	46.178	0.000
0.024	0.013	66.443	0.000	0.024	0.013	52.600	0.000	0.019	0.008	47.151	0.000
0.008	0.004	66.622	0.000	0.011	0.009	52.942	0.000	0.008	0.008	47.330	0.000
-0.025	-0.023	68.400	0.000	-0.020	-0.019	54.130	0.000	-0.017	-0.016	48.177	0.000
0.013	0.018	68.896	0.000	0.012	0.012	54.563	0.000	0.011	0.010	48.549	0.000
0.019	0.011	69.885	0.000	0.010	0.006	54.838	0.000	0.012	0.009	48.975	0.000

Note: AC-represents the values of the total autocorrelation function, PAC – represents the values of the partial autocorrelation functions, Q-Stat – represents the values calculated for the Ljung-Box test, Prob – represents the probabilities associated with the Ljung-Box test. The results are obtained by means of the Eviews statistical software.

The application of the Ljung-Box test to the square of index portfolio returns, as we have previously mentioned, can prove the existence of the dependence of returns anticipated from the graphical representation. The results obtained and presented in table 5 confirm the dependence of returns. As a consequence, the low values of the portfolios' returns are followed by high values regardless of sign while the low values are followed by low values. The dependence of returns shows that these can be modelled by means of the heteroskedastic models.

The heteroskedastic models taken into consideration have been presented in the second part of this paper.

As we have seen in the second part of the paper, in order to estimate the heteroskedastic models we need to identify the equation of the mean and the equation of the conditional variance. To estimate the conditional mean we use the ARMA(p,q) modelling, as we have already noticed, the returns of index portfolios are autocorrelated.

Table 5 - Testing the dependence of returns of index portfolios of environmental, social and governance stock leaders

LRENVD2				LRGOVD2				LRSOCD2			
AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
0.221	0.221	138.00	0.000	0.224	0.224	140.97	0.000	0.212	0.212	127.25	0.000
0.329	0.295	443.63	0.000	0.338	0.303	462.74	0.000	0.330	0.298	433.84	0.000
0.293	0.203	685.56	0.000	0.284	0.190	691.00	0.000	0.281	0.193	656.34	0.000
0.229	0.084	834.14	0.000	0.230	0.081	841.00	0.000	0.238	0.098	816.07	0.000
0.362	0.230	1203.7	0.000	0.415	0.297	1328.2	0.000	0.411	0.294	1293.9	0.000
0.217	0.047	1336.5	0.000	0.220	0.045	1464.6	0.000	0.214	0.042	1423.4	0.000
0.253	0.051	1517.2	0.000	0.272	0.046	1673.9	0.000	0.271	0.050	1630.9	0.000
0.211	0.015	1643.3	0.000	0.216	0.009	1806.1	0.000	0.215	0.011	1761.2	0.000
0.233	0.066	1797.2	0.000	0.236	0.058	1963.2	0.000	0.234	0.050	1916.4	0.000
0.281	0.103	2020.3	0.000	0.298	0.091	2215.1	0.000	0.289	0.081	2153.4	0.000
0.230	0.060	2170.1	0.000	0.230	0.053	2365.5	0.000	0.228	0.056	2300.2	0.000
0.260	0.068	2362.1	0.000	0.282	0.082	2590.2	0.000	0.275	0.080	2514.2	0.000

Note: AC-represents the values of the total autocorrelation function, PAC – represents the values of the partial autocorrelation functions, Q-Stat – represents the values calculated for the Ljung-Box test, Prob – represents the probabilities associated with the Ljung-Box test.
The results are obtained by means of the Eviews statistical software.

In order to choose the best mean equation since in this case the Akaike and Schwarz information criteria do not offer the same result we shall favour the Schwartz criterion , T. C., 1999]. Therefore, the estimated model for the mean is an autoregressive model of order AR(1). As we have previously seen when testing the stationarity of portfolios' returns, the daily mean of returns is not significantly different from zero; as a result, the estimated AR(1) model does not have the statistically significant intercept and we exclude it from the model.

We estimated heteroskedastic models with a different number of parameters and we took into consideration the three distributions used in the heteroskedastic modelling: normal distribution, standardized Student distribution and Generalized Error Distribution. For all the estimated models we took into account the Akaike, Schwarz, Adjusted R-Squared information criteria. Since these information criteria guide us towards the same model, in few cases we focused only on the Schwartz model, helping us to identify the best models with a reduced number of parameters. The best models are those with the lowest values for this criterion.

Of each category of heteroskedastic models tested we have chosen the best model. All these selected models were estimated by means of the Generalized Error Distribution. In the following two tables we present the estimated values of the parameters of the best estimated models for LRENVD.

Table 6 - The estimation of parameters of heteroskedastic models for LRENVD

	GARCH(1,1)	EGARCH(1,1)	TGARCH(1,1)	APGARCH(1,1)
a_1	0,131344***	0,134614***	0,135105***	0,134589***
α_0	0,008916***	-0,097263***	0,011399***	0,014675***
α_1	0,082168***	0,123916***	0,008090	0,065482***
γ_1		-0,096611***	0,129739***	0,800683***
β_1	0,910517***		0,916624***	0,931788***
δ		0,983749***		1,118776***
Schwarz	2,584507	2,561219	2,562379	***2,560943***

Note: models estimated by means of Generalized Error Distribution
*Note: *, **,***, indicate statistical significance for a taken risk of 10%, 5% and 1%*
The results are obtained by means of the Eviews statistical software.

In table 6 we estimate the heteroskedastic models which do not take into consideration the relationship between return and risk. The best model of those estimated is the APGARCH(1,1) model, according to the Schwarz information criteria.

We also took into consideration the models which estimate the relationship between return and risk. Since the estimated parameters are statistically significant, the correlation between risk and return is confirmed. The differences between the two selected models are very small according to the information criterion. We mention that all the estimated models meet the specific restrictions, the exception being represented by the GARCH(1,1) models which were not taken into consideration in the interpretation. All the estimated models also meet the hypotheses specific to the estimation of a regression model.

As a consequence, the model we focused on, APGARCH(1,1), confirms that the investors react differently according to the ascending or descending evolution of the market. On a descending trend market the volatility is higher than on a market with ascending trend and a new negative shock (a new piece of information) determines a higher variation/risk than a positive piece of information. Since the estimated value of the parameter δ is close to value 1 as Ding et al. (Ding, Granger and Engle, 1993) also underline the return under the form of the dependent variable in the APGARCH(1,1) model, it has a long memory meaning that the shocks on return persist in time.

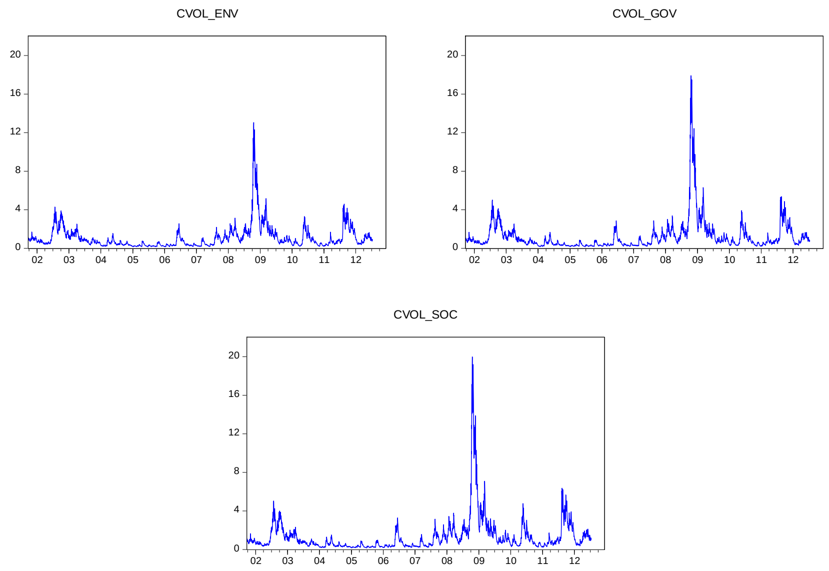
Table 7 - The estimation of parameters of the heteroskedastic models in mean for LRENV

	GARCH(1,1)-M	EGARCH(1,1) -M	TGARCH(2,1) -M	APGARCH(1,1) -M
$a_1^{'}$	0,091263***	0,059006***	0,059405***	0,058892***
a_1	0,117858***	0,127084***	0,123950***	0,127565***
α_0	0,009519***	-0,103754***	0,013383***	0,015172***
α_1	0,085349***	0,126368***	-0,034741**	0,066562***
α_2			0,051343***	
γ_1		-0,091433***	0,127810***	0,750312***
β_1	0,906732***		0,902042***	0,928402***
δ		0,983294***		1,100557***
Schwarz	2,580157	2,561283	2,562686	**2,561066**

Note: models estimated by means of Generalized Error Distribution
Note: *, **,***, indicate statistical significance for a taken risk of 10%, 5% and 1%
The results are obtained by means of the Eviews statistical software.

The best models for LRGOVD and LRSOCD are APGARCH(1,1)-M which indicates the same features as for LRENVD. The difference is expressed by the fact that the taking into consideration of the correlation between return and risk determines a better model. Therefore, the stocks' portfolios of social and governance stock leaders are characterized both by the correlation between risk and return (correlation much sought by the risk-averse investors) and by the risk asymmetry.

Figure 3 - The evolution of the conditional volatility of the returns LRENV, LRGOV, LRSOC



According to the figure above that presents the evolution of conditional volatility we seem not to notice any great differences of evolution of the conditional volatility of the portfolios of the three indices analyzed. We notice a difference at the end of the year 2008 and the beginning of the year 2009, during the global economic and financial crisis, when the portfolios register the greatest conditional volatility. The index portfolio of the environmental stock leaders has a lower volatility than the portfolios of the indices social and governance stock leaders.

2.3.The analysis of the correlation between the business cycles and the prices of the environmental social and governance stock leaders

The business cycle literature mentions that the stock exchange prices anticipate the global business cycles of an economy. Therefore, we aimed at analyzing whether the prices of environmental, social and governance stock leaders anticipate the business cycles of the Euro area and the USA.

The global business cycles in the Euro area and the USA were estimated based on the industrial production index because it is registered on a monthly basis in both areas. The choice of the gross domestic product would have forced us to analyze the quarterly data. For the estimation of the business cycles we used the Hodrick-Prescott filter.

Table 8 - The estimation of bivariate correlation coefficients between the stock prices of environmental, social and governance stock leaders and the business cycles from the Euro zone (with different lead).

	0	1	2	3	4	5	6	7
PENV	0.402968	0.464439	0.514992	0.544837	**0.561382**	0.560339	0.543836	0.520953
	(0.0000)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PGOV	0.393706	0.445933	0.488610	0.510893	**0.520995**	0.513531	0.490690	0.463171
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PSOC	0.375303	0.428779	0.472967	0.497630	**0.510764**	0.505997	0.485868	0.460907
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

The results are obtained by means of the Eviews statistical software.

In order to test if the prices for the environmental, social and governance stock leaders anticipate the business cycles in the Euro area and the USA, we estimated the bivariate correlation coefficient between the prices for environmental, social and governance stock leaders and the business cycles with different lead. Then we tested the significance of the bivariate correlation coefficients which were obtained. In the table below are presented the results.

Since the highest correlation coefficient is obtained for a lead equal to four, the prices of shares of environmental, social and governance stock leaders anticipate each business cycle in the Euro zone four months ahead.

Table 9 - The estimation of bivariate correlation coefficients between the stock prices of environmental, social and governance stock leaders and the business cycle in the USA with different lead

	0	1	2	3	4	5	6	7
PENV	0.416771	0.469391	0.518332	0.553770	0.567674	0.581668	**0.585796**	0.573127
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PGOV	0.405563	0.447801	0.487878	0.514620	0.521160	**0.528734**	0.526775	0.509226
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PSOC	0.383540	0.426620	0.468206	0.496422	0.506163	0.517065	**0.517178**	0.501904
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

The results are obtained by means of the Eviews statistical software.

The analysis conducted for the anticipation of the business cycles in the USA by the stock prices of environmental, social and governance stock leaders enables us to obtain different results from the Euro area. The stock prices of governance stock leaders anticipate the business cycles in the USA five months ahead and the prices of shares of environmental and social stock leaders six months ahead.

CONCLUSIONS

The analysis of return and risk of the index portfolios STOXX Global ESG Environmental Leaders, STOXX Global ESG Social Leaders, STOXX Global ESG Governance Leaders offered us the opportunity to discover important details regarding the Socially Responsible Investment. What we need to remark is that there are not significant differences between returns and the risk of the three portfolios.

The return distributions of the three portfolios are characterized by the lack of normality due to the excessive leptokurtosis, fact that shows to the investors they could obtain either very high profits or very high losses, higher than in the case of a normal situation. The returns of the three portfolios are autocorrelated, therefore they can be forecasted and they are also dependent, suggesting that the high values of returns are followed by high values, regardless of their sign, while low values are followed by low values, regardless of their sign. The index portfolios under analysis present the correlation between return and risk, feature which is preferred by the risk-averse investors. The risk of index portfolios is subjected to the asymmetry phenomenon, meaning that a new negative shock/piece of information on the market determines a higher volatility in comparison with a positive piece of information. The analysis of the correlation between the Euro area and the USA as well as the value of these index portfolios show that the stock exchange indices anticipate the business cycles in the Euro zone four months ahead and in the USA five or six months ahead.

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