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The Analysis of the CAC 40 National Index and of the Euronext 100 PAN-European Index Using Arch Models

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Abstract

Diversification purpose is to increase returns and reduce risk. In the context of the new architecture of European financial market, our purpose is to compare the behavior of the CAC 40 index and of the Euronext 100 index in the last 10 years, to identify commonalities in investing in the two indices, and an econometric model that takes into account the heteroskedasticity of financial series. Thus, by choosing the EGARCH model for both series, we can consider that due to financial integration, a shock that manifests in a national market has also repercussions on the European market.

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Keywords: home bias, risk, EGARCH, heteroskedasticity

1. Introduction

Passive strategies by copying the structure of an index solve many diversification requirements and instead provides low costs advantage. These strategies are being increasingly used by portfolio managers. Our purpose is to determine the relationship between two portfolios each following the structure of an index, one national (the CAC 40 index) and a pan-European index (the Euronext 100 index), by knowing the behavior of the indices in the last 10 years and statistical description of the distribution of daily profitability rates. Also, we aimed to identify the difficulties which forecloses portfolio managers to use a model for the rate of return, which would describe past developments but also future path of prices.

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The data used for the analysis of the Euronext 100 and the CAC 40 indices refer to daily closing prices and were processed in EViews and the daily rates of return were obtained using logarithmation.

Based on the estimate heteroskedastic models, we can assume that by holding this portfolio, managers do not benefit from a relationship between risk and return, as a specific characteristic of rational investors, the future evolution of profitability being influenced by information asymmetry.

2. Literature review

Capital investment strategy is determined by certain indicators, and factors such as the development of the capital market and if the securities are recognizable explains in a significant, but asymmetric, the investment location, investing in domestic assets (domestic investors crowd domestic market) or investing in external assets (the derating or overcharging of the foreign markets).

Since the late 1980s a number of studies have shown preference of American investors for shares from US market (Cooper and Kaplanis, 1994; Baxter and Jermann, 1995) and the preference of European investors for international markets (French and Poterba, 1991; Chan et al., 2004; Hasan and Simaan, 2000; Berglund and Aba Al-Khail, 2004).

Some studies have proposed to identify ruptures recorded by free capital movements. Portes and Rey (2000) and Vives (2001) analyzed the capital movements geographically and in time at international level. The authors argue that in the absence of legislative barriers for financial transactions, the volume of transferred capital should be influenced by geographical distance, market size and the level of involvement of those responsible for international informational connections.

Adam et al. (2002) conducted a report on the indicators of price return of capital markets. Since models based on asset prices are difficult to analyze and require more time to be able to provide relevant estimations, the report considers the correlations between portfolio returns an alternative indicator, especially due to its simplicity.

In the studies of time series, it have been used for a long time ARMA model, being easy to estimate, based on the method of least squares (Chirilă, 2004). ARMA model estimation of the parameters requires condition of homoskedasticity insurance and financial series have characteristic features of heteroskedasticity and asymmetry.

The ARCH model (Autoregressive Conditional Heteroskedasticity) was proposed by Engle in 1982, and take into consideration the variation leptokurtic of returns and volatility of returns over time. EGARCH type models (Exponential Generalized ARCH) were introduced by Nelson (1991), completing the first generation of GARCH models such as ARCH (p) model belonging to Engle (1982) and GARCH (p, q) developed by Bollerslev (1986) or GARCH-M model (Engle et al., 1987), which introduced the idea of volatility clustering, weak shocks that are followed by strong shocks, but only signaling shock magnitude and not it sign.

Numerous studies highlight the superiority of EGARCH for modeling return of shares: Awartani and Corradi (2005) in the study of S&P 500 index, Cao and TSAY (1992), Heynen and Kat (1994). Tudor (2008) for BET-C index, considered it suits best GARCH (1,1), used by some authors to model interest rate changes (Alexander and Lazar, 2006) because the latter does not fully capture the appearance of "heavy tails" and arching rates of return.

3. Research Methodology

The CAC 40 Index is the benchmark for Euronext Paris market and is an active basis for index futures contracts and options. Base value is 1000 set at 31 December, 1987. On 1 July 2014 the index value was 4461.12 EUR.

The basic amount Euronext 100 index is 1000 set at December 31, 1999. The rules of composition Euronext 100 ensures that the index is the largest and most liquid for stocks traded on Euronext. On 18 June 2012 value of the index was 847.34 EUR.

We assume that a portfolio will follow exactly the composition of pan-European Euronext 100 index. Retail investors are interested to have a diversified portfolio, and this type of passive management solves the problem of high costs. We assume also that another portfolio tracks the evolution of the CAC 40 national stock exchange index in Paris.

By processing the closing prices in EViews, we provide a descriptive statistical analysis of the behavior of the two indices over the past 10 years, resulting in an econometric model available for their development. To use the data in

Eviews, we use rates of return of the Euronext 100 and the CAC 40 indices, obtained by logarithmation of closing prices.

In the study of time series were used for a long period of time ARMA models, being easy to estimate based on the method of least squares. Estimation of ARMA model parameters requires provision of homoscedasticity condition, but characteristic features of financial series are asymmetry and heteroscedasticity. The ARCH (Autoregressive Conditional Heteroskedasticity) was proposed by Engle in 1982, and took into account the leptokurtic variation of returns and its volatility over time. The ARCH models drop the assumption of homoscedasticity of stock returns (Dragotă et al., 2003).

An ARCH (2) based on a model ARMA (1,1) is in the form of the following equation:

$r_t = \beta_0 + \beta_1 r_{t-1} + \varepsilon_t - \alpha_1 \varepsilon_{t-1}$ (1)

$\sigma_t^2 = \delta_0 + \delta_1 \varepsilon_{t-1}^2 + \delta_2 \varepsilon_{t-2}^2,$ (2)

where: rt- the return of the asset/portfolio;

σt2- the conditional variance of errors; the conditional variance of errors in day t taking into account the information available at time t-1.

Because the conditional variance is zero or positive, must be ensured the following conditions:

$\delta_0 > 0, \delta_1, \delta_2, \delta_3, \ldots, \delta_p \geq 0$

The GARCH model takes into account the characteristics of the ARCH model and the presence of volatility clustering (Brooks, 2008).

$\sigma_t^2 = \delta_0 + \delta_1 \varepsilon_{t-1}^2 + \delta_2 \varepsilon_{t-2}^2 + \ldots + \delta_p \varepsilon_{t-p}^2 + \phi_1 \sigma_{t-1}^2 + \ldots + \phi_q \sigma_{t-q}^2$ (3)

This model highlights that the conditional variance ε at time t, is dependent on the value of the error in the previous period, as in the ARCH (1), and on the conditional variance of the previous period (Gujarati, 2004).

Conditional variance is positive if the terms of the equation are positive and stationarity condition is ensured if the sum of the terms is less than 1.

EGARCH models (Exponential Generalized ARCH) introduced by Nelson (1991), fill the first generation of GARCH models, which introduced the idea of volatility clusters, that shocks are followed by strong shocks, but shows only its magnitude and not its sign.

Using EGARCH model is modeled asymmetry phenomenon of news impact on variables: a negative shock of the same force with a positive shock leads to a greater increase in volatility.

$$ln\sigma_t^2 = \delta_0 + \delta_1 \left| \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} \right| + \gamma_1 \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \lambda_0 ln\sigma_{t-1}^2 \quad (4)$$

EGARCH models do not require positive coefficients for modeling the logarithm of the conditional variance, being the model that folds best to explain portfolio returns compared to other GARCH models.

4. Empirical Results

First we perform a descriptive analysis of primary data describing the state and variability (Jaba, 2002). Relevant data for the index are the closing prices of the trading day.

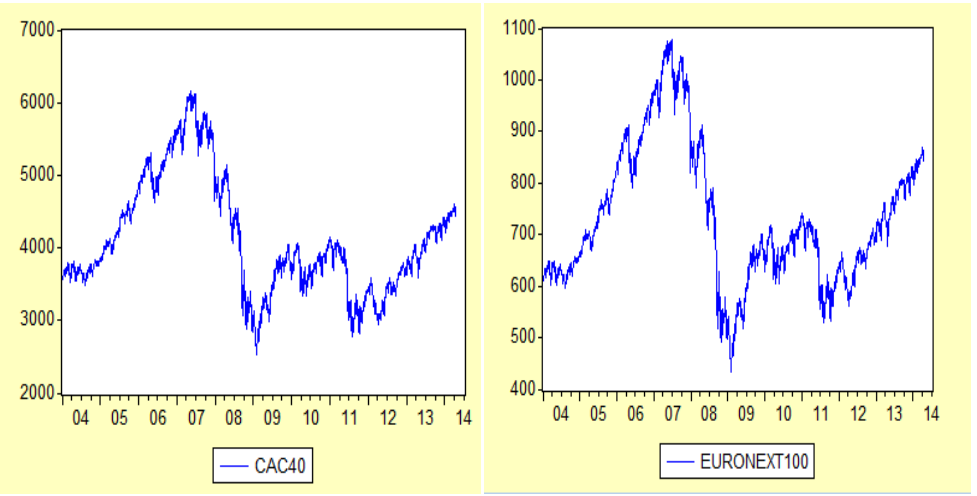

Fig. 1: The graphs for the Euronext 100 index and the CAC 40 index, based on closing prices during 01.01.2004-30.06.2014
Source: EViews processing

From the graphical representation for the two indices we can see a similar path for closing prices caused by the same shocks. For portfolios with the same periods analyzed we observed downward trend and uncertainty, due to negative shocks such as the terrorist attacks of September 11, the war in Iraq, natural disasters and the euro crisis, which affected investor confidence in the capital market.

The period that followed the mid-2008 was characterized by instability in European Union countries because they had difficulties in managing public debt, with impact on the confidence of investors in financial and economic entities from these countries. A strong decrease of the two indices was recorded in early 2009 when the financial crisis made its presence felt in the European Union. In 2011, governments fail to stimulate economies, losing the confidence of economic and financial institutions. As a result, expenditures and private sector investment dropped sharply, causing a vicious circle which led to high unemployment and slow economic growth.

The following table, based on daily returns of the CAC 40 and the Euronext 100 indices will achieve a primary statistical data.

Table 1: Descriptive Indicators for the returns of the two series

Descriptive indicators	CAC 40	Euronext 100
Mean	0.007691	0.011581
Median	0.043085	0.060533
Maximum	10.59459	10.32160
Minimum	-9.471537	-8.951124
Standard Deviation	1.412659	1.282070
Skewness	0.041980	-0.032556
Kurtosis	10.18853	11.04072
Number of observations	2688	2688

Sources: EViews processing

The standard deviation of portfolio analysis can be used as a measure of risk. The risk of a portfolio is as small as the standard deviation of the portfolio and vice versa (Isaic-Maniu et al., 1999).

According to the level of risk indicator (standard deviation), we observe that the CAC 40 index portfolio is riskier than the Euronext 100 index portfolio, supporting the idea of portfolio diversification, with foreign shares.

After testing, with a probability of 0.6396> 0.05, for lrEuronext, and with a probability of 0.7778> 0.05 for lrcac, it's accepted the null hypothesis that the two values of means do not significantly differ from zero.

Asymmetry coefficient is greater than zero in the CAC 40 index case, 0.041980> 0, and for the Euronext 100 index is smaller, -0.032556 <0. Thus, we can say that about the CAC 40 index that it shows a slight asymmetry to the right and about Euronex100 index that it shows a slight asymmetry to the left.

Normal value of Kurtosis indicator is 3, but financial series usually have a higher value. In turn, the CAC 40 index has a value of kurtosis equal to 10.18853> 3, and for the Euronext 100 has a value of 11.04072> 3, which means that in the case of Euronext 100, minimum and maximum values deviate in a higher number from the mean calculated.

Further, due to heteroskedasticity we will try to identify an ARCH model type for each of the two indices. To estimate a model for the daily rates of returns for the CAC 40 index, we identified following patterns and the model chosen is the one with minimum Schwarz criterion.

Table 2: Heteroscedastic models which describe the daily return of the CAC 40 index portfolio, based on the informational criterions

Possible models	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quin Criterion	No autocorrelation hypothesis	Homoscedasticity hypothesis
GARCH(2,1)	3.137920	3.153281	3.145588	accepted	accepted
EGARCH(2,1)	**3.075908**	**3.093463**	**3.082258**	**accepted**	**accepted**
PARCH(1,1)	3.085005	3.102560	3.091355	rejected	rejected
TARCH(2,1)	3.137920	3.153281	3.143476	accepted	accepted
GsARCH-M(2,1) Std.Dev.	3.138404	3.155960	3.144755	accepted	accepted
GARCH-M(2,1) Variance	3.138629	3.156183	3.144979	accepted	accepted
GARCH-M(2,1) Log(Var)	3.138149	3.155703	3.144499	rejected	accepted

Source: EViews processing

The chosen model is EGARCH (2,1).

The hypothesis for normality of errors was tested using Jarque Bera test.

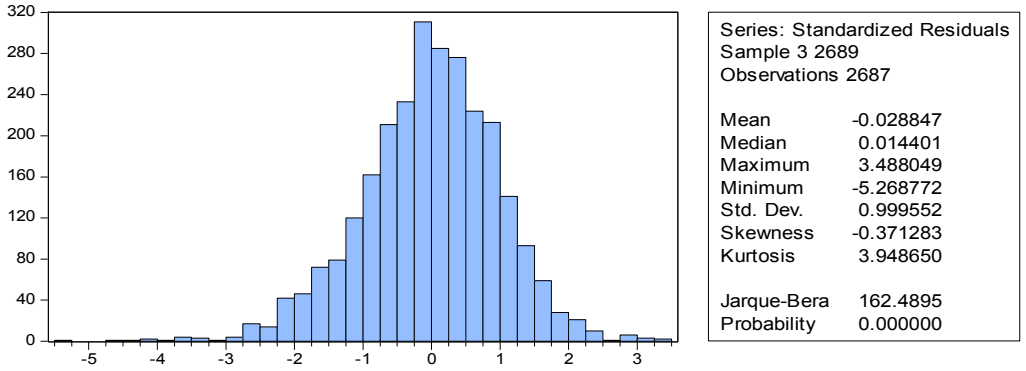

Fig. 2: Histogram distribution for the CAC 40 index

Source: EViews processing

Analysis indicates that the residuals are not normally distributed according to Jarque Bera test ($p < 0.05$). Because the sample size is large, the average error is not significantly different from zero, and focus errors around the mean, we believe that the violation of normality assumption does not significantly affect the quality model.

Effect of asymmetry is revealed by $\gamma 1$. This parameter estimated should be significant and lower than zero ($\gamma 1 = -0.088448$).

EGARCH model equation (2.1) for the returns of the CAC 40 index portfolio is composed of the following:

$$ln\sigma_t^2 = -0.076034 - 0.088448 * \left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}}\right| + 0.190114 * \left|\frac{\varepsilon_{t-2}}{\sqrt{\sigma_{t-2}^2}}\right| - 0.188108 * \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + 0.966921 * ln\sigma_{t-1}^2$$

In our attempts for identifying the heteroscedastic model for the Euronext 100 index daily return, we identified seven posibilities, from which we will choose the model with the minimum value for informational criterion.

Table 3: Heteroscedastic models for describing the daily return of the portfolio following the Euronext 100 index, selected on the basis of

informational criterions

Possible models	Akaike Information Criterion	Schwarz Information Criterion	Hannan-Quinn Criterion	No autocorrelation Hypothesis	Homoscedasticity Hypothesis
GARCH(2,1)	2.914546	2.927708	2.919307	accepted	accepted
EGARCH(2,1)	**2.852054**	**2.867410**	**2.857608**	**accepted**	**accepted**
PARCH(1,1)	2.856554	2.871909	2.862108	rejected	rejected
TARCH(1,1)	2.917100	2.928068	2.921067	accepted	accepted
GARCH-M(1,1) Std.Dev	2.916949	2.930111	2.921710	accepted	accepted
GARCH-M(1,1) Variance	2.917407	2.930569	2.922168	accepted	accepted
GARCH-M(1,1) Log(Var)	2.916680	2.929842	2.921441	accepted	accepted

Source: EViews processing

For daily return of the Euronext 100 index EGARCH model equation (2.1) is:

$$ln\sigma_t^2 = -0.095701 - 0.044625 * \left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}}\right| + 0.170570 * \left|\frac{\varepsilon_{t-2}}{\sqrt{\sigma_{t-2}^2}}\right| - 0.166686 * \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + 0.971326 * ln\sigma_{t-1}^2$$

Lowest Schwarz information criterion is for model EGARCH (2,1), which is the best model of representation for portfolio returns which copies the structure of the Euronext 100 index.

Since γ1= -0.044625 is less than zero, portfolio returns show the phenomenon of shock asymmetry. In this case, a negative shock of the same force with a positive shock leads to greater volatility of the portfolio.

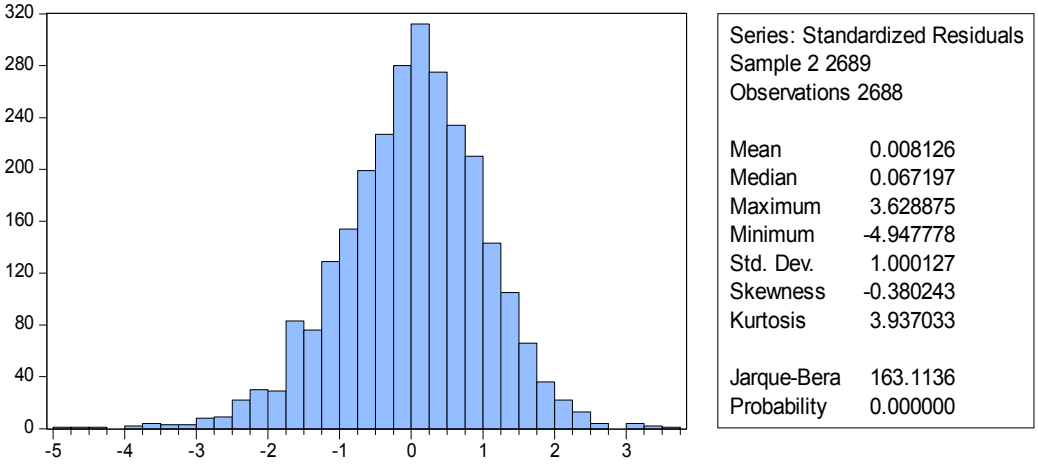

Fig. 3: Histogram distribution for the Euronext 100 index

Sources: EViews processing

For both portfolios we have identified an optimal EGARCH (2,1) model. Since γ1 <0, portfolio return presents asymmetry of shocks. Using EGARCH model is modeled phenomenon of asymmetry of the impact of news on variables: a negative shock of the same force with a positive shock leads to a greater increase in portfolio volatility.

If γ = 0 then the model is symmetric. When γ <0, positive shocks generate less volatility than negative ones. If γ> 0, implies that positive information is more "disturbing" than negative ones.

Based on estimated heteroscedastic models, on average, we can say that by holding this portfolio we do not benefit from a relationship between risk and return, characteristic to rational investors and the future evolution of profitability is influenced by information asymmetry.

Conclusions

The descriptive statistics shows that the two portfolios composed of CAC 40 and Euronext 100 indices will conduct to daily rates of return specific to financial series: rates of return do not follow a normal distribution, there are minimum and maximum values which are deviating from the mean, and the results obtained in the last 10 years were divided in roughly equal proportions, in gains and losses.

After several attempts we found for both portfolios an EGARCH model, a model that emphasizes the relationship between return and volatility, and a negative coefficient which expresses the fact that volatility is influenced in a greater measure by negative shocks than by positive shocks, although they have the same intensity. This is demonstrated, in practice, by the evolution of stock prices over the last ten years, when information from the economic environment (terrorist attacks, natural disasters, wars) have affected in a very high dimension the return on assets.

In conclusion, both portfolios can be modeled by model EGARCH (2,1), and the explanation for this could be the high level of influence of the shares held by the CAC 40 index portfolio on the Euronext 100 index portfolio.

We can also conclude that the level of integration of the two markets is high enough so that profitability achieved by investing in the portfolio of one index will have the same results like investing in the second index, but according to the risk level indicator (standard deviation), it appears that the CAC 40 index is riskier than the Euronext 100, which supports the idea of portfolio diversification, with foreign shares.

In conclusion, we note the integration degree of financial markets in the European Union. Of course there are also emerging markets where it is currently not possible trading certain securities, but the development of the capital market is directly related to the level of economic development, so we believe that when financial markets will be perfectly integrated, that will be a request naturally imposed by the investors and issuers from the global market.

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