International Gold Market, Stock Market and Business Cycles: the Central and Eastern European Countries

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Abstract: During the economic recession periods, gold investments seem to become very important because gold is considered a means to preserve the investment value. Gold has also maintained this feature during the financial and economic crisis that occurred at the end of the year 2007. Although the inflation rate has recorded significant increases, the investment in gold has kept its value because the price of gold has increased. After the beginning of the financial and economic crisis the price of gold has also recorded a significant increase in volatility. The aims of this study focus on the comparative analysis of the gold price cycles and the stock market cycles in the Central and East Europe as well as the determination of the return of gold investment on the return and risk of stock markets in these countries. The results obtained confirm that both the return and the risk in some of the stock markets under analysis are influenced by the return of gold investment.

Keywords: asymmetric volatility; EGARCH; Hodrick-Prescott filter

JEL Classification: E32; C 18; C22

1 Introduction

The identification of influence factors of return and risk of stock markets is a topic that attracts both investors and theoreticians. The price of gas, the exchange rate, the price of houses as well as the price of gold represents potential causes of the evolution of stock markets.

The market model which was discovered by Markowitz (1959) based on the discovery of empirical connections between the stock returns and the return of stock market and which was later on developed by Sharpe (1964) show that the returns of stock generally evolve in the same direction as the stock market. The exception from this rule is represented by few stocks. Some of them are the gold mines. They generally evolve in a contrary direction from

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that of the stock market. If during the economic growth period and also during the ascending evolution of the stock market, the stocks of the gold exploitation companies are less attractive, during the economic downturn periods and the stock market recession they become attractive since they offer the possibility to diversify the portfolio of financial assets, to reduce the risk and to ensure the portfolio. The effective purchase of gold may be an alternative to the investments in financial assets.

In the last years, the gold request has burst out on one hand due to the occurrence of the global financial and monetary crisis that determined the entrance in recession of the USA and the European countries and on the other hand due to the reduction in global gold production and the existence of a significant gold demand. The occurrence of economic recession has caused an inflation increase (Gagea, 2011). Since gold is known as an investment that maintains its value, regardless of the stages of the business cycles, it has been a possibility to preserve value and therefore the investors have allocated a part of their resources for gold purchase. During this time, due to the economic crisis in China and India, one could notice an increase in gold demand.

Most of the studies which analyze the role of gold price on the stock price take into consideration the long-term evolution. The methodology used to reach this objective is cointegration. Due to the fact that Baur D.G.'s study (Baur, 2010) identifies a reaction of gold investments within the daily data and not in the weekly or monthly ones, we propose to analyze this correlation on a short term period.

Ciner C.'s analysis (Ciner, 2001) shows that gold has played an important role in the portfolio diversification. Baur D. G. (Baur, 2010) analyzes the role gold has in the global financial system and draws the conclusion that gold can be considered an asset offering the possibility to ensure the financial asset portfolios. The conclusions he reaches are valid for the daily data, underlying the fact that the investors react very quickly to the shocks on the market. This situation is valid for the developed countries. In the emerging countries the investors do not ensure the portfolio of financial assets through the purchase of a certain asset such as gold, thus they suffer losses.

Wang M.-L. et al. (Wang et al., 2010) prove that there is not a long-term relation between the price of gas, the price of gold and the exchange rate and the stock markets for the USA but this relation exists for Germany, Japan, Taiwan and China.

We can find the testing of influence of gold price on the stock markets in Indonesia, Thailand, Vietnam, Philippines and Malaysia in Do G. Q.'s paper (Do, 2009). To reach the objectives of the paper, he uses the heteroscedastic models GARCH(1,1)-X and GJR(1,1)-X. The results confirm that three of the five stock markets are influenced by the return of gold investment.

The purpose of the present paper is on one hand to analyze the evolution of the gold market in comparison with the stock markets in Central and Eastern Europe by comparing the cycles of gold price with the cycles of stock markets and on the other hand to test if the international gold return has a short-term influence on the return and risk of stock markets in the Central and Eastern European countries.

2. Methods

In order to compare the business cycles of gold price with the business cycles of stock markets in the Central and East European countries we went through several stages. The first stage was represented by the estimation of business cycles by means of the Hodrick-Prescott (Hodrick, Prescott, 1997) filter. This filter is very frequently used in the estimation of business cycles and it is also much criticized since it tends to underestimate the cyclic component (Rand & Tarp 2002). The cyclic component is obtained as a difference between the variable used and the estimated trend.

By means of the Hodrick-Prescott filter the trend is determined by minimizing the expression

$$\sum_{t=1}^{t} c_t^2 + \lambda \sum_{t=2}^{t} \left[\left(g_t - g_{t-1} \right) - \left(g_{t-1} - g_{t-2} \right) \right]^2$$

Where: $c_t = lny(t) - lny^*(t)$

$g_t = lny^*(t+1)$

$g_{t-1} = lny^*(t)$

$g_{t-2} = lny^*(t-1)$

y^* - the long-term trend of the variable y.

For the parameter λ the most frequently used value for the monthly data is 144000. Since we use daily data we take into consideration the implicit value from the Eviews software equal to 6812100.

In order to test the existence of the cyclic component for a time series we use the Ljung-Box test. The tested hypotheses are: the null hypothesis H_0 implies that the variable is for a white noise and the alternative hypothesis H_1 implies that the variable is autocorrelated, a feature specific for the business cycles. The test statistics is computed according to the relation:

$$Q_k = T\left(T+2\right)\sum_{i=1}^{k}\frac{\hat{\rho}_i^2}{T-i}$$

If the null hypothesis is rejected the time series is not a white noise and presents a cyclic component.

After the estimation of the business cycles of the variables comprised in the study we continue with the analysis of their bivariate correlation coefficients. (Jemna D., 2012). We estimate the bivariate correlation coefficients $\rho\left(j\right)$ for the different values of j, $j \in \left\{0,\pm1,\pm2,\pm3,...\right\}$. A variable is acyclical if the bivariate correlation coefficient $\rho\left(0\right)$ is zero and it is pro-cyclical if the bivariate correlation coefficient $\rho\left(0\right)$ is positive and countercyclical if the bivariate correlation coefficient $\rho\left(0\right)$ is negative. The correlation coefficients may indicate whether the analyzed cycles lead the cycle with j periods if $\left|\rho\left(j\right)\right|$ has the highest value for a positive j; it lags the cycle with j periods if $\left|\rho\left(j\right)\right|$ has the highest value for a negative j or it is synchronous with the business cycles if $\left|\rho\left(j\right)\right|$ has the highest value for $j = 0$ (Agenor et alii, 1999).

In order to determine if the global return of gold investments has an influence on the return and risk of stock markets in the Central and East Europe, we will model the returns by means of the heteroscedastic models and then we will introduce the variable return of gold investment in the previously estimated heteroscedastic models. We will take into consideration the models GARCH, TGARCH, EGARCH and PGARCH which will be estimated taking into account different error distributions: normal, Student and GED. The heteroscedastic models are specific to the financial variables which are characterized by autocorrelation, dependence, asymmetry, leptokurtosis (or fat tails) and cluster presentation.

The estimation of heteroscedastic models implies the estimation of two equations: the first equation represents the mean equation that is usually represented by an ARMA model while the second one is the variance equation. The GARCH(p,q) model was proposed by Bollerslev in 1986. It is as follows:

- the ARMA(1,1) model for return: $r_t = a_0 + a_1 r_{t-1} + \varepsilon_t - m_1 \varepsilon_{t-1}$

- $h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-q}^2$

In order for the conditioned variance to be positive $h_t = \dfrac{\alpha_0}{1 - \sum_{i=1}^{p} \alpha_i - \sum_{j=1}^{q} \beta_j}$ the following conditions should be met: $\alpha_0 > 0$, $\alpha_i \geq 0$, $\beta_j \geq 0$. The stationary condition is also met if $\sum_{i=1}^{p} \alpha_i + \sum_{j=1}^{q} \beta_j < 1$.

In order to test the influence of return of gold investments on the return and risk of stock markets we introduced as a factor, both in the mean equation and in the variance equation, as well as in the GARCH model and in the TGARCH, EGARCH and PGARCH models, the return of gold investment as follows:

$$r_t = a_0 + a_1 r_{t-1} + \varepsilon_t - m_1 \varepsilon_{t-1} + \phi_1 r_{at} + \phi_2 r_{at-1}$$

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-q}^2 + \theta_1 r_{at} + \theta_2 r_{at-1}$$

The TGARCH, EGARCH and PGARCH models succeed to capture in the modeling the asymmetry phenomenon. The asymmetry phenomenon involves the asymmetry of the impact of new events on return: a negative piece of information of the same intensity as a positive one determines a higher increase in volatility.

The TGARCH model was proposed by Zakoian in 1994:

$$h_t = \alpha_0 + \sum_{i=1}^{p}\left[\alpha_i \varepsilon_{t-i}^2 + \gamma_i \varepsilon_{t-i}^2 d_{t-1}\right] + \sum_{j=1}^{q}\beta_j h_{t-j}$$

Where: d_{t-1} - dummy variable (binary),

$d_{t-1} = 1$ if $\varepsilon_t < 0$ and

$d_{t-1} = 0$ in what follows.

The conditioned volatility is positive when the estimated parameters meet the following conditions:

$\alpha_0 > 0, \alpha_i \geq 0, \alpha_i + \gamma_i \geq 0, \beta_j \geq 0$.

The EGARCH model

$$- \ln h_t = \alpha_0 + \sum_{i=1}^{p}\left[\alpha_i \left|\frac{\varepsilon_{t-i}}{\sqrt{h_{t-i}}}\right| + \gamma_i \frac{\varepsilon_{t-i}}{\sqrt{h_{t-i}}}\right] + \sum_{j=1}^{q}\beta_j \ln h_{t-j}$$

The existence of asymmetry is highlighted by the estimation of the parameter γ_i. If the parameter is statistically significant then there is an asymmetric reaction of volatility based on the new information occurring on the market.

Ding et alii. (1993) propose the Aymmetric Power ARCH (A-PARCH). The conditioned variance for a A-PARCH (1,1,1) is modeled according to the relation:

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

The parameters obtained must meet the following conditions: $\delta \geq 0$, $\alpha_0 > 0$ $\alpha_1 \geq 0$, $\beta_1 \geq 0$ and $|\gamma_1| \leq 1$. If $\gamma_1 \neq 0$, the conditioned volatility is asymmetric.

When estimating the conditioned volatility we used the normal distribution proposed by Engle in 1983 (Engle, 1983), the standardized Student t distribution proposed by Bollerslev (1987) and the Generalized Error Distribution proposed by Nelson in 1991 (Nelson, 1991). In our study we will estimate the heteroscedastic models by taking into consideration these three distributions.

3. Data and Empirical Analysis

The stock markets in the Central and East European countries are analyzed by means of their general indicators. The countries considered in the analysis are: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania and Slovenia. The time period for the analysis is 1/03/2000 – 4/30/2012 for which a maximum of 3,216 daily observations are registered. The values of the indices are taken from the websites of the stock markets under analysis. The gold price for the same period was taken from the site World Gold Council. Based on figure 1, we may ascertain that there is a similar evolution of the indices of stock markets in the Central and East European countries during the analyzed period. The stock markets of these countries register in the first period a significant increase until the moment of beginning of the global financial crisis at the end of the year 2007 and then it records a sudden downfall due to the economic recession period. At the end of the analyzed period a return of the growth trend is again noticed. The exception is represented by Slovenia which experienced a sudden growth at the end of the year 2005 and entered the recession period a little bit later than the other countries.

As for the evolution of the global price of gold, it registers an ascending trend as well as short downfall periods. The temporary decreases in gold price are much smaller than the decreases registered by the stock markets.

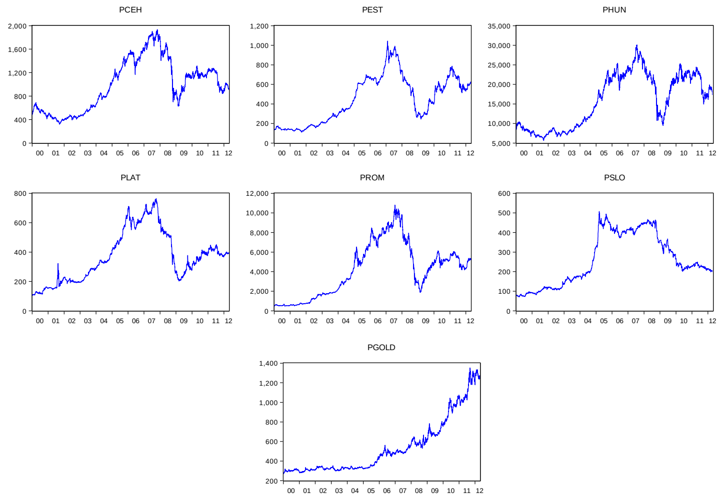

Figure 1. The evolution of indices of the stock markets in the Central and East European countries and of the price of gold during 1/03/2000 – 4/30/2012

Based on the observations 3215 log-returns are obtained (or continuous compounded returns) using the formula:

$$r_t = \left(\ln P_t - \ln P_{t-1}\right)\cdot 100$$

Where:

r_t - Continuously compounded return

P_t, P_{t-1} - Index portfolio price at time t and t-1, respectively.

Since the returns of the stock markets determined on the basis of reference indices are stationary (according to annex 1) their means may be considered the returns an investor expects to obtain if he invests in those respective stock markets. As one can also observe from the table below the average returns are very different: the lowest value is for the stock market in the Czech Republic, of only 0.0202% per day, while the highest value is for the stock market in Romania of 0.0769% per day.

The total risk measured by means of the standard deviation has the lowest value for the stock market in Lithuania while the highest value is held by the Romanian stock market. The median of returns is equal to zero for the Czech Republic, Hungary, Latvia and Slovenia, which proves that the investors have 50% chances to obtain a profit and 50% chances to obtain losses while in the case of Estonia, Lithuania and Romania, the median is positive, meaning that the investors have more than 50% chances to obtain a profit.

Table 1. Descriptive statistics for the analyzed returns

	CEH	EST	HUN	LAT	LIT	ROM	SLO	GOLD
Mean	0.0202	0.046	0.022	0.041	0.037	0.076	0.028	0.0458
Median	0.000	0.041	0.000	0.000	0.011	0.024	0.000	0.033
Maximum	12.36	12.09	13.17	10.17	11.00	11.54	11.88	7.838
Minimum	-16.18	-7.045	-12.64	-14.70	-11.93	-13.11	-14.81	-8.56
Std. Dev.	1.523	1.210	1.646	1.546	1.147	1.756	1.213	1.088
Skewness	-0.464	0.128	-0.075	-0.606	-0.485	-0.375	-0.944	-0.156
Kurtosis	14.80	10.72	8.80	17.46	20.46	10.42	20.22	8.68
Jarque-Bera	18769	7993.2	4509.3	28240	40964	7455.4	40206	4346.6
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Obs.	3215	3215	3215	3215	3215	3215	3215	3215

Source: Results obtained by means of the Eviews software programme

All the return distributions present a negative asymmetry and have a strong leptokurtic feature that is why the distributions do not follow a normal distribution as the Jarque-Bera test shows. The daily returns of gold investments present the specific characteristics of the stock market returns: negative asymmetry, leptokurtosis, they do not follow a normal distribution law. Moreover, as annex 2 shows, the returns of gold investments, as well as all the returns of the analyzed stock markets are autocorrelated and dependent (the high values are followed by high values regardless of their symbol and the low values are followed by low values).

3.1. The analysis of the cycles of the international gold market in comparison with the stock markets in the Central and East Europe

The business cycles of the stock markets and of the gold investment were estimated by means of the previously presented Hodrick-Prescott filter. The variables of the business cycles present autocorrelation according to the results obtained by applying the Ljung-Box test. The results obtained for the bivariate correlation coefficients show that the stock market cycles in Estonia, Hungary and Romania lag the cycle by 15 days, those in the Czech Republic lag the cycle by 12 days, in Latvia they lag the cycle by 13 days and those from Lithuania and Slovenia lag the cycle by 16 days.

Table 2 The bivariate correlation coefficients between the business cycles of the stock markets in the Central and Eastern Europe and the business cycles of the global gold investment with different lags

	GLD	GLD(-5)	GLD(-12)	GLD(-13)	GLD(-15)	GLD(-16)
CEH_C	-0.248*	-0.293*	-0.317*	-0.316*	-0.308*	-0.302*
EST_C	-0.131*	-0.200*	-0.271*	-0.276*	-0.281*	-0.281*
HUN_G	-0.284*	-0.338*	-0.386*	-0.389*	-0.390*	-0.387*
LAT_C	-0.219*	-0.254*	-0.285*	-0.286*	-0.280*	-0.277*
LIT_C	-0.092*	-0.153*	-0.227*	-0.232*	-0.237*	-0.239*
ROM_C	-0.280*	-0.310*	-0.332*	-0.333*	-0.333*	-0.326*
SLO_C	-0.089*	-0.102*	-0.112*	-0.116*	-0.122*	-0.123*

Note: *, **,***, indicate statistical significance for a taken risk of 1%, 5% and 10%

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

The business cycles of the stock markets in the Central and East European countries under analysis are countercyclical in comparison with the business cycles of the global gold investment because the bivariate correlation coefficient $\rho(0)$ is negative.

3.2. Determining the Influence of Return of Gold Investments on the Returns of the Stock Markets in Central and East Europe

The returns of the index portfolios as well as the returns of gold investments are dependent; therefore they can be modeled by means of heteroscedastic models. Firstly, we identified the corresponding ARMA model for the mean equation in the heteroscedastic models. We chose the Schwarz criterion, its minimal value indicating the best model, because it offers the possibility to identify the models with fewer parameters in comparison with the Akaike criterion. As it was obvious, the errors resulted from the estimation of ARMA models do not meet the homoscedasticity hypothesis, therefore we went on with the estimation of the previously presented hereroscedastic models. We chose the best estimated models, also according to the Schwarz criterion. After their estimation, we introduced the mean equation and the variance equation off the return of global gold investment and we presented them in the table below. The estimated models meet the hypotheses specific to a regression model.

Table 3. The estimation of heteroscedastic models of the index portfolio returns in the Central and Eastern European countries

Var. Parameters	CEH	EST	HUN	LAT	LIT	ROM	SLO
a_0	0.07*	0.04***	0.024	0.041*	0.06***	0.069*	0.163*
a_1	0.042**	1.092*	0.219*	-	0.944*	-	-
a_2	-0.03***	-0.126*	-0.844*	-	-0.801	-	-
m_1	-	-0.942*	-0.217*	-0.084*	-0.083*	0.091*	-0.007
m_2	-	-	0.809*	-	-	-	-
ϕ_1	0.071*	0.003	0.04***	0.012	0.039*	0.04***	0.004
ϕ_2	-0.03***	-0.001		0.000	-	-	0.018
α_0	0.049*	0.007*	0.066*	0.064*	-0.134*	-0.274*	-0.064*
α_1	0.063*	0.342*	0.045*	0.168*	0.187*	0.488*	0.128*
α_2	-	-0.235*	-	-	-	-	-
γ	0.092*	0.020	0.074*	0.084**	-0.029*	-0.05**	-0.023*
β_1	0.863*	0.920*	0.8885*	0.8048*	0.9644*	0.9145*	0.9643*
δ	-	1,090*	-	-	-	-	-
θ_1	0.05***	-0.017	0.052**	0.01	-0.050*	0.08*	0.055*
θ_2	-0.019	0.0201		-0.0011	0.0521*	-0.044*	-0.034*
Distrib.	Student	Student	GED	GED	Normal	Student	Normal
Model	TGARCH	PGARCH	TGARCH	TGARCH	EGARCH	EGARCH	EGARCH

Note: *, **,***, indicate statistical significance for a taken risk of 1%, 5% and 10%

The results presented in the table above show that between the return of gold investment and the return of stock market in the Czech Republic and Lithuania there is a direct correlation. This situation shows a similar evolution in the two possibilities to invest since when the return of the stock market has an ascending trend the return of gold investment also increases. If we take a higher risk of up to 10% we could ascertain that there is also such correlation for the stock market in Romania and Hungary.

As regards the risk, the stock markets in Estonia and Latvia are not influenced by the return of gold investment, therefore when the return of gold investment increases the risk of stock markets in these countries also increases. If we take into account that during the economic downturn periods the risk of stock markets significantly increases, we may conclude that in times of economic recession the returns of gold investments also increase. For Romania and Slovenia there is a statistically significant correlation between the return of gold investment and the return of stock market from the previous day but an inverse one. As a consequence, if one day the return of gold investment increases we may say that the investors are attracted by it the following day. On the stock market when the buying or selling interventions decrease, volatility also decreases.

4. Conclusions

This paper aimed to analyze the business cycles of the stock markets in Central and East Europe in comparison with the business cycles of the gold price. We took into consideration the estimation of these cycles within the daily data since the previous research shows fast changes of goals in the investments in stock markets. The comparative study of these cycles shows that the business cycles of the stock markets in the Central and East European countries under analysis are countercyclical comparatively with the business cycles of gold investments.

The analysis of the stock markets in Central and East Europe and the modeling of their return and volatility indicate that these are characterized by the phenomenon of volatility asymmetry. The results also confirm the influence of price of gold especially on the volatility of stock markets.

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ANNEX 1

Table 1. The results of testing stationarity for daily index portfolio return during the analyzed period

Variable/ Characteristics	Model with intercept	Model with intercept and trend	Model without intercept and trend
LRCEH			
ADF test	-40.91670	-40.93252	-40.91245
Probability	0.0000	0.0000	0.0000
Schwarz	3.678831	3.680972	**3.676496**
LREST			
ADF test	-48.38181	-48.39192	-48.32658
Probability	0.0001	0.0000	0.0001
Schwarz	3.199194	3.201399	**3.197775**
LRHUN			
ADF test	-26.95596	-26.95645	-26.94685
Probability	0.0000	0.0000	0.0000
Schwarz	3.830859	3.833309	**3.828527**
LRLAT			
ADF test	-28.59861	-28.65947	-28.56225
Probability	0.0000	0.0000	0.0000
Schwarz	3.697635	3.699220	**3.695700**
LRLIT			
ADF test	-49.21033	-49.21923	-49.17328
Probability	0.0001	0.0000	0.0001
Schwarz	3.098087	3.100309	**3.096355**
LRROM			
ADF test	-50.64350	-50.71283	-50.56412
Probability	0.0001	0.0000	0.0001
Schwarz	3.956413	3.957571	**3.955430**
LRSLO			
ADF test	-57.92414	-58.09015	-57.90007
Probability	0.0001	0.0000	0.0001
Schwarz	3.229197	3.228622	**3.227269**
LRGOLD			
ADF test	-59.04599	-59.05841	-58.93972
Probability	0.0001	0.0000	0.0001
Schwarz	3.005660	3.007788	**3.005183**

ANNEX 2 Testing the autocorrelation of the index portfolio returns for the CEE countries

Table 1. Testing the autocorrelation o index portfolio returns in the Czech Republic and Estonia

	LRCEH				LREST			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	0.070	0.070	15.692	0.000	0.156	0.156	78.448	0.000
2	-0.052	-0.057	24.400	0.000	0.059	0.036	89.711	0.000
3	-0.046	-0.039	31.339	0.000	0.042	0.029	95.469	0.000
4	0.026	0.029	33.465	0.000	0.034	0.022	99.228	0.000
5	0.044	0.035	39.587	0.000	0.028	0.017	101.74	0.000
6	-0.016	-0.021	40.395	0.000	0.049	0.040	109.58	0.000
7	-0.004	0.005	40.450	0.000	0.042	0.026	115.25	0.000
8	0.015	0.016	41.134	0.000	0.038	0.024	119.99	0.000
9	0.017	0.011	42.019	0.000	0.042	0.027	125.58	0.000
10	-0.017	-0.019	42.987	0.000	0.062	0.047	138.07	0.000
11	-0.019	-0.013	44.163	0.000	0.040	0.017	143.13	0.000
12	0.061	0.062	56.142	0.000	0.042	0.025	148.89	0.000

Table 2. Testing the autocorrelation o index portfolio returns in the Hungary and Latvia

	LRHUN				LRLAT			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	0.051	0.051	8.2698	0.004	0.054	0.054	9.2841	0.002
2	-0.076	-0.079	26.905	0.000	0.106	0.104	45.610	0.000
3	-0.020	-0.012	28.160	0.000	0.025	0.015	47.658	0.000
4	0.087	0.083	52.287	0.000	-0.078	-0.092	67.213	0.000
5	0.035	0.024	56.324	0.000	-0.031	-0.027	70.212	0.000
6	-0.056	-0.047	66.277	0.000	-0.050	-0.030	78.153	0.000
7	-0.022	-0.009	67.793	0.000	-0.037	-0.024	82.572	0.000
8	0.021	0.010	69.227	0.000	0.005	0.011	82.658	0.000
9	-0.005	-0.016	69.317	0.000	0.045	0.049	89.050	0.000
10	-0.051	-0.041	77.588	0.000	0.078	0.068	108.47	0.000
11	0.001	0.011	77.591	0.000	0.061	0.039	120.59	0.000
12	0.027	0.016	79.925	0.000	0.079	0.056	140.67	0.000

Table 3. Testing the autocorrelation of index portfolio returns in Latvia and Romania

	LRLIT				LRROM			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	0.140	0.140	63.143	0.000	-0.494	-0.494	785.91	0.000
2	0.068	0.049	77.937	0.000	-0.000	-0.323	785.91	0.000
3	0.052	0.037	86.677	0.000	-0.000	-0.237	785.91	0.000
4	0.042	0.028	92.425	0.000	0.001	-0.182	785.91	0.000
5	0.012	-0.002	92.905	0.000	0.001	-0.143	785.91	0.000
6	0.079	0.074	112.89	0.000	0.001	-0.113	785.92	0.000
7	0.068	0.046	127.65	0.000	-0.002	-0.094	785.93	0.000
8	0.088	0.067	152.86	0.000	0.001	-0.077	785.93	0.000
9	0.069	0.040	168.20	0.000	0.000	-0.064	785.93	0.000
10	0.068	0.040	183.08	0.000	0.000	-0.053	785.93	0.000
11	0.042	0.016	188.81	0.000	0.000	-0.044	785.93	0.000
12	0.055	0.032	198.64	0.000	-0.001	-0.037	785.93	0.000

Table 4. Testing the autocorrelation of index portfolio returns in Slovakia and as well as the returns of gold investments

	LRSLOV				LRGOLD			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	-0.022	-0.022	1.5782	0.209	-0.039	-0.039	4.9828	0.026
2	0.039	0.038	6.3531	0.042	-0.032	-0.033	8.2410	0.016
3	-0.016	-0.014	7.1305	0.068	0.016	0.013	9.0454	0.029
4	-0.048	-0.050	14.429	0.006	0.016	0.016	9.9043	0.042
5	0.030	0.029	17.369	0.004	-0.020	-0.018	11.238	0.047
6	-0.001	0.004	17.372	0.008	-0.031	-0.032	14.327	0.026
7	0.015	0.011	18.102	0.012	-0.038	-0.042	18.970	0.008
8	0.036	0.035	22.310	0.004	0.042	0.037	24.654	0.002
9	0.007	0.011	22.480	0.007	0.055	0.058	34.351	0.000
10	0.020	0.017	23.766	0.008	-0.004	0.005	34.399	0.000
11	0.016	0.018	24.560	0.011	-0.055	-0.054	44.158	0.000
12	0.038	0.041	29.309	0.004	-0.025	-0.036	46.143	0.000

ANNEX 3. Testing the dependence of index portfolio returns of the CEE countries

Table 1 Testing the dependence of index portfolio returns in the Czech Republic and Estonia

	LRCEH2				LREST2			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	0.322	0.322	333.69	0.000	0.150	0.114	201.76	0.000
2	0.294	0.212	611.63	0.000	0.086	0.038	225.32	0.000
3	0.335	0.225	973.24	0.000	0.105	0.070	260.83	0.000
4	0.284	0.120	1233.9	0.000	0.106	0.066	297.35	0.000
5	0.314	0.149	1551.0	0.000	0.072	0.021	313.85	0.000
6	0.168	-0.063	1641.5	0.000	0.063	0.021	326.46	0.000
7	0.162	-0.021	1725.9	0.000	0.055	0.019	336.21	0.000
8	0.225	0.074	1888.9	0.000	0.101	0.069	369.13	0.000
9	0.268	0.150	2121.2	0.000	0.115	0.070	411.70	0.000
10	0.323	0.196	2458.5	0.000	0.111	0.055	451.48	0.000
11	0.256	0.080	2669.8	0.000	0.115	0.058	494.12	0.000
12	0.169	-0.080	2762.5	0.000	0.200	0.200	129.29	0.000

Table 2 Testing the dependence of index portfolio returns in the Hungary and Latvia

	LRHUN2				LRLAT2			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	0.216	0.133	460.64	0.000	0.475	0.475	725.03	0.000
2	0.161	0.070	544.59	0.000	0.361	0.176	1145.5	0.000
3	0.149	0.069	616.25	0.000	0.283	0.077	1402.9	0.000
4	0.144	0.064	682.84	0.000	0.252	0.075	1607.8	0.000
5	0.197	0.122	807.53	0.000	0.324	0.188	1946.9	0.000
6	0.165	0.054	895.55	0.000	0.285	0.055	2208.4	0.000
7	0.226	0.131	1060.9	0.000	0.227	-0.006	2374.7	0.000
8	0.256	0.135	1271.8	0.000	0.200	0.018	2503.7	0.000
9	0.262	0.120	1493.4	0.000	0.252	0.122	2708.7	0.000
10	0.141	-0.033	1557.8	0.000	0.241	0.033	2896.8	0.000
11	0.148	0.025	1628.1	0.000	0.343	0.180	3275.6	0.000
12	0.310	0.310	309.77	0.000	0.265	-0.005	3501.6	0.000

Table 3 Testing the dependence of index portfolio returns in and Lithuania and Romania

	LRLIT2				LRROM2			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	0.380	0.380	464.35	0.000	0.500	0.500	803.48	0.000
2	0.272	0.149	702.62	0.000	-0.001	-0.334	803.48	0.000
3	0.257	0.134	914.49	0.000	-0.001	0.250	803.48	0.000
4	0.168	0.013	1005.7	0.000	-0.001	-0.200	803.48	0.000
5	0.166	0.058	1094.3	0.000	-0.001	0.166	803.48	0.000
6	0.154	0.043	1170.9	0.000	-0.001	-0.143	803.49	0.000
7	0.118	0.011	1215.5	0.000	-0.001	0.125	803.49	0.000
8	0.108	0.017	1253.4	0.000	-0.001	-0.111	803.49	0.000
9	0.121	0.045	1301.0	0.000	-0.000	0.100	803.49	0.000
10	0.102	0.016	1334.8	0.000	-0.000	-0.091	803.49	0.000
11	0.113	0.038	1376.3	0.000	-0.000	0.083	803.49	0.000
12	0.117	0.033	1420.7	0.000	-0.000	-0.077	803.49	0.000

Table 4 Testing the dependence of index portfolio returns in Slovakia and as well as the returns of gold investments

	LRSLOV2				LRGOLD2			
	AC	PAC	Q-Stat	Prob	AC	PAC	Q-Stat	Prob
1	0.026	0.026	2.1770	0.140	0.173	0.173	96.372	0.000
2	0.016	0.015	3.0089	0.222	0.150	0.124	168.73	0.000
3	0.044	0.043	9.1629	0.027	0.121	0.080	215.47	0.000
4	0.013	0.011	9.7412	0.045	0.141	0.099	279.90	0.000
5	0.018	0.016	10.816	0.055	0.216	0.169	430.83	0.000
6	0.002	-0.001	10.836	0.094	0.124	0.044	480.58	0.000
7	0.025	0.023	12.789	0.077	0.098	0.020	511.35	0.000
8	0.010	0.007	13.095	0.109	0.124	0.059	560.81	0.000
9	0.005	0.003	13.165	0.155	0.069	-0.012	576.01	0.000
10	0.039	0.037	18.120	0.053	0.136	0.064	636.07	0.000
11	0.002	-0.001	18.133	0.079	0.096	0.025	665.54	0.000
12	0.145	0.144	86.312	0.000	0.104	0.037	700.54	0.000