GLOBAL FINANCIAL CRISIS AND UNIT-LINKED INSURANCE MARKETS EFFICIENCY: EMPIRICAL EVIDENCE FROM CENTRAL AND EASTERN EUROPEAN COUNTRIES

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This paper empirically investigates the impact of the Global financial crisis on the efficiency of four Central and Eastern European emerging unit-linked insurance markets, applying the automatic variance ratio (AVR) test of Kim (2009) and variance ratio tests using ranks and signs by Wright (2000) for entire, pre-crisis and crisis periods. This study contributes to the existing literature on efficient market hypothesis with several distinct features: it provides a systematic review of the weak-form market efficiency literature that examines return predictability of the daily ING unit-linked funds prices; also the article aims at monitoring any improvement in the degree of efficiency in time and also examines the relative efficiency of unit-linked insurance markets in pre-crisis and crisis periods. Unit linked insurance are life insurance policies with investment component. In the literature there are few studies investigating the effects of a financial crisis on the potential of predictability and implicitly on the degree of efficiency of financial markets. The occurrence of a market crash or financial crisis is a possible contributing factor of market inefficiency. Most of the studies are focused on the Asian crisis in 1997: Holden et al. (2005) examined the weak-form efficiency of eight emerging Asian stock markets using VR tests before, during and after the Asian crisis; Kim and Shamsuddin (2008) used three different types of multiple VR tests for nine Asian stock markets; the findings reported by Lim et al. (2008) are consistent with those reported by Cheong et al. (2007), in which the highest inefficiency occurs during the crisis period. Todea and Lazar (2010) investigated the effects of the Global crisis on the relative efficiency of ten CEE stock markets, using Generalized Spectral test of Escanciano and Velasco (2006). Wright (2000) proposes the alternative non-parametric variance ratio tests using ranks and signs of return and demonstrates that they may have better power properties than other variance ratio tests. Kim (2009) found that the wild bootstrap AVR significantly improves the size and power properties of the AVR test. Using the bootstrapped automatic VR test developed by Kim (2009) and Wright's test, the statistical findings show that the degree of the markets' inefficiency varies through time and surprisingly the empirical results suggest that the Global crisis led to a decrease of predictability and hence to an improvement of relative efficiency for five of the eight ING funds.
Keywords: Global financial crisis, unit-linked insurance markets, market efficiency, martingale, variance ratio test.
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1. Introduction

Although the efficient market theory and the random walk hypothesis have been major issues in financial literature for the past thirty years, there are only few studies investigating the impact of the global financial crisis on the potential of predictability and implicitly on the degree of efficiency of financial markets, respectively of Central and Eastern European unit-linked insurance markets.

The global financial crisis has negatively influenced the evolution of European unit-linked investment funds. Unit linked insurance are life insurance policies with investment component.

The insurance premiums are invested into one or more investment funds, managed by the insurance company. Each investment fund has its own unit with individual prices. In case of unit-linked insurance policies the investment risks are on the insurance person's side, but the benefits of the investment depend on the investment funds' evolutions.

The efficient market hypothesis (Fama, 1970:383-417) can be viewed as the cornerstone of modern finance. Since the seminal papers of Samuelson (1965) and Fama (1970), the efficient market hypothesis states that efficient market prices follow a random walk or a martingale. When the market is efficient, all available information is fully and instantaneously reflected in price, and no market participant is able to make abnormal profit. When the information set is limited to past price and return, the market is said to be weak-form efficient and the asset return is purely unpredictable from the past information. Most of the efficient market hypothesis studies on financial markets are tested for the weak-form efficiency through the martingale difference hypothesis MDH, where the current price is the best predictor of the future price and the returns are independent or uncorrelated with the past values. According to Lo (2004), there is no consensus among finance academics and practitioners as to whether stock market is efficient. While most of finance researchers believe the market is weak-form efficient (see Doran, et al. 2009), there are some critics who support the idea of maximum predictability (DeBondt and Thaler 1985, Barber and Ordean 2001). Grossman and Stiglitz (1980) even argue that a perfectly efficient market is impossible. In response to these critics, Campbell et al. (1997) proposed the concept of relative efficiency. With relative market efficiency, it is useful to measure the degree of efficiency or return predictability. The common idea of these studies is the fact that the rejection/acceptance of random walk hypothesis (RWH) is equivalent to the hypothesis of inefficiency/ efficiency. Todea and Lazar (2010) stated that a rejection of the hypothesis of efficiency over the whole sample could either mask subperiods of efficiency, or the fact that markets are becoming more efficient over time, so a more accurate approach would be to identify subperiods of efficiency/inefficiency and to rank the relative market efficiency.

The objective of this article is to empirically investigate the effects of the recent Global crisis on the degree of efficiency or return predictability of four Central and Eastern unit-linked insurance markets using the automatic variance ratio (AVR) test of Kim (2009) and rank-based variance ratio tests by Wright (2000). This study contributes to the existing literature on EMH with several distinct features: this paper provides a systematic review of the weak-form market efficiency literature that examines return predictability from past price changes, with an exclusive focus on the unit-linked insurance markets. Moreover, the article aims at monitoring any improvement in the degree of efficiency in time and also examines the relative efficiency of markets in pre-crisis and crisis periods.

The structure of the article is as follows. Section 2 discusses some previous research on the issue. Section 3 and 4 describe the sample data and provides descriptive statistics and outlines the methodology. Empirical results are presented in Section 5. The conclusions are drawn in Section 6.

2. A review of related literature

The globalization of financial markets broadcasted the interest of most of the contemporary empirical tests for the Efficient Market Hypothesis in individual or regional markets from Latin America (Urrutia 1995, Grieb and Reyes 1999, Charles and Darne 2009 etc.), Africa (Smith et al. in 2002, Magnusson and Wydick 2002 etc.), Asia (Huang 1995, Groenewold and Ariff 1998, Kim şi Shamsuddin 2008 etc.), Middle East (Abraham et al. 2002, Al-Khayali et al. 2007 etc), Europe (Worthington and Higgs 2004, Smith 2009, Charles et al. 2009 etc).

The occurrence of a market crash or financial crisis is a possible contributing factor of market inefficiency. This is because investors are generally swamped by panic in that chaotic financial environment, and thus causing a decrease in the degree of efficiency. Thus, Holden et al. (2005)

examined the weak-form efficiency of eight emerging Asian stock markets using VR tests before, during and after the Asian crisis. For most markets, there is no improvement in the degree of efficiency in post-crisis period, except for Taiwan. Using three different types of multiple VR tests for nine Asian stock markets, Kim and Shamsuddin (2008) divided their sample into sub-sample I (1990–1996) and sub-sample II (1998–2005) in order to separate the effect of the 1997 financial crisis. The results of this study show that the stock markets of Hong Kong, Japan and Taiwan remain efficient even after the crisis. The findings reported by Lim *et al*. (2008) are consistent with those reported by Cheong *et al*. (2007), in which the highest inefficiency occurs during the crisis, followed by the pre-crisis and post-crisis periods. Todea (2010) investigated the effects of the Global crisis on the relative efficiency of ten CEE stock markets. The results of the Generalized Spectral test of Escanciano and Velasco (2006) show a decrease of predictability and an improvement of relative efficiency for seven of the ten investigated markets in the crisis period.

3. The data and its properties

The present paper focuses on four Central and Eastern European unit-linked insurance markets and the closing values of ING unit-linked funds at daily frequency for these markets are collected as follows: Czech Republic (Bond Fund, Junior Fund), Hungary (Bond Unit Fund, Balanced Unit Fund), Poland (Bonds Sub-Fund, Balanced Sub-Fund), Romania (Bond Fund, Mixt 25 Fund). All four ING Bond fund portfolios invest 100% in domestic instruments with fixed income. And the rest of ING fund portfolios invest 15-50% in shares issued by companies from the European Union, in particular Romania, Hungary, Poland and the Czech Republic, and instruments with fixed income denominated in national currency**.** All the closing prices of these funds collected from ING database are denominated in their respective local currency units. The data starts from 21 July 1999 and ends at 12 April 2012.

(Table 1) provides the descriptive statistics for the continuously compounded percentage returns, computed as $Y_t = \ln(P_t) - \ln(P_{t-1})$ (1), where P_t and P_{t-1} denote the closing price of the unit-linked fund on two consecutive trading days. To address the impact of the Global financial crisis on market efficiency, one has to first identify the crisis period. The downward trend started in most cases in the middle of 2008.

Table 1. Descriptive statistics of returns for pre-crisis and crisis periods

Market	**Czech Republic**		**Hungary**		**Poland**		**Romania**	
Pre-crisis	***Bond***	***Junior***	***Bond***	***Balanced***	***Bond***	***Balanced***	***Bond***	***Mixt 25***
Mean	0.000130	0.000162	0.000302	0.000335	0.000287	0.000394	0.000568	0.000608
St. Dev.	0.001520	0.002213	0.003245	0.006215	0.001619	0.006526	0.001620	0.004417
Skewness	0.245899	-0.473242	-1.451530	-0.24874	0.271131	-0.24251	6.569553	2.298665
Excess Kurtosis	8.999322	7.620678	27.274590	5.988092	9.712003	5.576193	58.933100	42.661400
Crisis	***Bond***	***Junior***	***Bond***	***Balanced***	***Bond***	***Balanced***	***Bond***	***Mixt 25***
Mean	0.000093	-0.000033	0.000226	0.000053	0.000214	-0.00005	0.000249	0.000249
St. Dev.	0.002457	0.003000	0.006730	0.009986	0.001937	0.008674	0.000929	0.004181
Skewness	-1.303614	-1.036878	0.165583	-0.16966	-0.42613	-0.27038	-2.857740	-0.228594
Excess Kurtosis	17.589080	14.280630	13.150470	7.372269	8.999322	5.538333	73.990120	7.851020

Test is performed by the authors using software Eviews.

The Global crisis had a significant impact on the markets' performance, the highest decreases in prices were recorded for the Czech Republic Junior Fund and Poland Balanced Sub-Fund. During

the crisis period the highest increases of volatility are found in the case of Hungary funds and Poland Balanced Sub-Fund. In general, the daily returns are negatively skewed, which means that large negative returns are more probable than the higher positive returns. The excess kurtosis is positive for all indexes which indicates an increased number of returns around the average, comparative to the normal law.

4. Methodology. Automatic bootstrapped VR test developed by Kim (2009) and Variance Ratio Tests Using Ranks and Signs developed by Wright (2000)

The variance ratio test has been used widely as a mean of testing for the weak-form efficiency of financial markets, and of evaluating predictability of financial return. Since Lo and MacKinlay (1988) proposed its original form, the test has undergone a number of improvements, including the multiple variance ratio test of Chow and Denning (1993), sign and rank tests of Wright (2000), wild bootstrap test of Kim (2006), power-transformed test of Chen and Deo (2006) and bootstrapped automatic VR test of Kim (2009). The test is based on the property that, if an asset return is purely random, the variance of k-period return is k times the variance of the one-period return. The VR test evaluates the hypothesis that a given time series or its first difference (or return), is a collection of independent and identically distributed observations or that it follows a martingale difference hypothesis. Wright (2000) proposes the alternative non-parametric variance ratio tests using ranks and signs of return and demonstrates that they may have better power properties than other variance ratio tests. First, his tests often allow for computing the exact distribution. As it is not necessary to appeal to any asymptotic approximation, size distortions can be neglected. Second, tests based on ranks and signs may be more powerful than other tests if the data are highly non-normal.

When returns are subject to an unknown form of conditional heteroscedasticity, Kim (2009) proposes to employ the wild bootstrap of Mammen (1993) to improve small sample properties, as in Kim (2006) who applied the wild bootstrap to the Lo-MacKinlay and Chow-Denning tests. The wild bootstrap for $AVR(\hat{k})$ can be conducted in three stages as follows: form a bootstrap sample of T observations $Y_t^* = \eta_t Y_t$ (2) (t=1,…,T), where η_t is a random sequence with $E(\eta_t) = 0$ (3) and $E(\eta_t^2) = 1$ (4); calculate $AVR^*(\hat{k}^*)$, the AVR statistic obtained from $\{Y_t^*\}_{t=1}^T$; and repeat the previous stages B times to form a bootstrap distribution $\{AVR^*(\hat{k}^*; j)\}_{j=1}^B$.The two-tailed p-value of the test is obtained as the proportion of the absolute values of $\{AVR^*(\hat{k}^*; j)\}_{j=1}^B$ greater than the absolute value of $AVR(\hat{k})$.

5. Empirical results

We investigate the weak-form EMH for ING Czech Republic Bond Fund and Junior Fund, ING Hungary Bond Unit Fund and Balanced Unit Fund, ING Poland Bonds Sub-Fund and Balanced Sub-Fund, and ING Romania Bond Fund and Mixt 25 Fund by testing the MDH from wild bootstrapped AVR test and Wright's test. The (Table 2) displays the AVR test statistics for entire, pre-crisis and crisis periods. Bold letters indicate significant value at a 5% level of significance.

Table 2. The AVR test statistics for the entire, pre-crisis and crisis periods

Period	The entire period	Pre-crisis	Crisis	The entire period	Pre-crisis	Crisis
	ING Czech Republic Bond Fund			**ING Hungary Bond Unit Fund**		
Period	7/21/99-4/12/12	7/21/99-9/17/08	9/18/08-4/12/12	7/21/99-4/12/12	7/21/99-7/31/08	8/1/08-4/12/12

Period	The entire period	Pre-crisis	Crisis	The entire period	Pre-crisis	Crisis
AVR	**8.163652**	**4.100492**	**5.546805**	**4.05785**	1.780431	**3.006886**
p-value	**0**	**0**	**0.002**	**0.038**	0.359	**0.031**
	ING Poland Bonds Sub-Fund			**ING Romania Bond Fund**		
Period	7/21/99-4/12/12	7/21/99-2/4/08	2/5/08-4/12/12	7/21/99-4/12/12	7/21/99-10/7/08	10/8/08-4/12/12
AVR	**9.995314**	**10.7963**	**2.974359**	**5.402333**	**4.927309**	-1.737583
p-value	**0**	**0**	**0.027**	**0**	**0**	0.388
	ING Czech Republic Junior Fund			**ING Hungary Balanced Unit Fund**		
Period	7/21/99-4/12/12	7/21/99-9/17/08	9/18/08-4/12/12	7/21/99-4/12/12	7/21/99-7/31/08	8/1/08-4/12/12
AVR	2.70222	-0.2343008	3.387348	**3.847812**	1.853926	2.854542
p-value	0.091	0.753	0.041	**0.014**	0.061	0.058
	ING Poland Balanced Sub-Fund			**ING Romania Mixt25 Fund**		
Period	7/21/99-4/12/12	7/21/99-2/4/08	2/5/08-4/12/12	7/21/99-4/12/12	7/21/99-10/7/08	10/8/08-4/12/12
AVR	**3.739357**	**3.156231**	1.728902	**3.764244**	**3.502065**	1.366356
p-value	**0.002**	**0.005**	0.067	**0.001**	**0.002**	0.197

Test AVR is performed by the authors using software R.

Over the entire period, we observe that the martingale hypothesis is clearly rejected on the vast majority of unit-linked insurance markets, except for ING Czech Republic Junior Fund, at 0.05 significant level. In general, the high degree of predictability and implicitly of inefficiency of the four CEE unit-linked insurance markets is observed also in the two subperiods, except for ING Czech Republic Junior Fund, ING Hungary Bond Unit Fund and Balanced Unit Fund in pre-crisis period and the ING Czech Republic Junior Fund, ING Poland Balanced Sub-Fund, ING Hungary Balanced Unit Fund, ING Romania Bond Fund and Mixt 25 Fund in crisis period. Also the Wright's variance ratio test rejects the null hypothesis at a 5% level of significance, for all of the unit funds at most of the aggregation levels. The test statistics R1, R2 and S1 are using the following k aggregation values: 2, 5, 10 and 30. The Wright's test statistics suggest a surprising increase of the degree of efficiency in the crisis period, exceptions being ING Czech Republic Bond Fund and ING Romania Mixt25 Fund for all aggregation levels.

6.Conclusions

The efficient market hypothesis (Fama, 1970) can be viewed as the cornerstone of modern finance. One implication of the efficient market hypothesis is that when purchasing a security, you cannot expect to earn an abnormally high return, a return greater than the equilibrium return. Many studies shed light on whether investment advisers and mutual funds beat the market.

This study investigates the effects of the Global crisis on the relative efficiency of four CEE unit-linked insurance markets, an issue which is surprisingly understudied in the literature. Using the bootstrapped automatic VR test developed by Kim (2009), the statistical findings show that the degree of the markets' inefficiency varies through time. Only in the case of ING Czech Republic Junior Fund, the martingale hypothesis is accepted for the entire period and for the two superiods. Both of the tests suggest that the ING unit values that register an increase of predictability, correspond to ING less risky funds that invest 100% in domestic instruments with fixed income.

Surprisingly the AVR and Wright's empirical results suggest that the Global crisis led to a decrease of predictability and hence to an improvement of relative efficiency for five of the eight ING funds. On the other hand, an opposite result, that of a decrease of efficiency's degree in the

crisis period, was observed by AVR statistics for ING Czech Republic Bond Fund, ING Poland Bonds Sub-Fund and ING Hungary Bond Unit Fund and by Wright's test statistics for ING Czech Republic Bond Fund, ING Hungary Bond Unit Fund and ING Romania Mixt25 Fund.

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