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stability tested using MRS model**



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Abstract

Systemic risk came into attention in the period of recent financial crisis. Importance of financial intermediation of investment funds is posing to a systemic influence of this sector to a stability of a financial market and therefore whole financial sector. This was proven through investment behavior, fire sales and net outflows from investment funds during the financial crisis. The article is testing systemic risk of whole range of different UCITS investment funds and behavior of these institutions as well as influence on financial market stability. Methodology is based on Markov regime switching model. A conclusion in this article proves existence of systemic risk in returns of analyzed UCITS investment funds and their strong systemic interconnections with returns and volatility on a financial market. Different investment strategy and type of UCITS investment fund shows no resistance to systemic risk according to this research.

Key words

systemic risk, UCITS investment funds, financial stability, interconnectedness, Markov regime switching model

JEL classification

G23, G15, G01, C58

1. Introduction

Systemic risk in finance has been in focus of expert and scientific literature for a longer period of time. However, recent financial crisis and its dramatical consequences have only highlighted systemic risk as an essential risk exposure of traditional and contemporary financial institutions and markets. It therefore understands that the issue of managing and measuring systemic risk is one of key interests for scientific, expert, regulatory and practical development. Over the last several years, many research on defining systemic risk, methodology of its measurements and development of regulatory framework have been conducted. Although clear and unambiguous research and methodology results have not yet become common or accepted, many developed countries have already implemented concrete regulatory changes, as well as established various committees for macroprudential regulation and systemic risk management.

Investment funds are indispensable financial intermediaries of every developed financial system with their special role of dominantly acquiring retirement savings or investments of the household sector. The importance of investment funds for financial systems, measured in the ratio of investment funds assets in the structure of assets of all financial institutions ranged from 21.5% in the USA to 14.3% in the EU countries at the end of 2013 (Board of Governors of the Federal Reserve System and ECB, 2014). Investment funds differ in investment strategy, which is defined by the fund type, organisational framework and legal treatment. UCITS investment funds (*Undertakings for Collective Investment in Transferable Securities*), the subject study of this paper, represent investment funds of a single market of financial services in the European union, established according to UCITS Directives. The first UCITS Directive was accepted in 1985, with its last changes being made in 2014 to now UCITS V Directive. At the end of 2013, the total net assets of investment funds in Europe was 9,768 billion EUROS, with 71% of these assets referring to UCITS investment funds, while the rest were nationally regulated or other investment funds (Non-UCITS) (EFAMA, 2014). The financial crisis had a significant impact on business activities of UCITS investment funds. In 2008 only, the total net assets of UCITS investment funds were reduced by 26.4%, while net outflows were 356 billion EUROS (EFAMA, 2011).

The aim of this paper is to analyse and point at systemic risk in business activities of different types of UCITS investment funds and to point out the connection between systemic risk of UCITS investment funds and trends on the financial market. This research will analyse returns of UCITS investment funds and chosen stock indices, as well as volatility index. The paper will re-examine the following hypotheses:

- H1. The UCITS funds returns and the returns of stock indices are characterised through two different regimes: calm and turbulent,
- H2. In returns of different types of UCITS funds, systemic risk have been emphasized by overlaps in regime occurrences.
- H3. Different types of UCITS investment funds, according to investment strategy, do not show resilience towards systemic risk and systemic interconnection of returns of investment funds and stock indices.
- H4. Systemic risk and regime occurrence among indices of UCITS investment funds overlap with movements in returns of chosen stock indices and volatility index (VIX index).

The paper uses Markov regime switching model methodology as one of recent methodologies for measuring systemic interconnections and testing financial crisis influence on returns of institutional investors, as well as stock indices. Data tested are returns of BAIF UCITS fund of funds indices of

UCITS investment funds. They represent indices of UCITS investment funds with similar investment strategy, ranging from bond funds, different stock strategies to mixed UCITS funds. Trends on capital market have been analysed through returns of significant stock indices and VIX index.

The paper is divided into five parts. After the introduction, the second part reviews characteristics of systemic risk and review of literature in this field of finance. The third part presents chosen methodology and data, the fourth part reveals research results and the last, fifth part, ends with discussion and conclusions.

2. Characteristics of systemic risk and literature review

It seems that despite a general understanding of systemic risk, its exact definition still causes problems. It can be said that systemic risk is most often identified and explained with “bank runs”, “fire sales”, financial instability, “collapse risk” or “domino effect”. However, a clearer or more precise qualitative and quantitative definition of the systemic risk, as well as its measuring methodology, which could eventually lead to the assumption of efficient regulatory interventions or a trigger for government interventions in order to preserve financial stability, has not been defined.

In that sense, Taylor (2009) emphasized that every definition of systemic risk should be based on the three following assumptions: (1) the cause of general financial instability can be any particular, but significant event, such as bankruptcy of a certain institution, a steep fall in the value of one or more indices on the capital market, the crisis of a certain financial sector segment, a collapse in financial infrastructure or occurrence of a catastrophic event and loss, (2) due to “financial contagion” or “chain reaction”, particular problems can quickly spread to a larger part or even to the entire financial system and (3) financial system instability has direct negative consequences on the economy as a whole (Taylor, 2009).

For the fulfilment of the second Taylor assumption, three forms of spreading systemic risk through the sector of investment funds can be highlighted: a significant fall in investment funds asset value (fall of capital market), changes in investment strategies and portfolio herding, fire sales and net outflows. ORF (2013) lists the following as asset management sector short-comings: return orientation strategy and “herd behaviour”, redemption and disinvestment risk, financial leverage and bankruptcy risk for a particular company. Disturbances on the market caused by fire sales and risk exposure, relations with creditors, other parties, investors and market participants are emphasized by systemic risk transmission channels (ORF, 2013).

In the „Group of Ten“ (2001) report on financial sector consolidation, systemic risk is defined as the risk or danger that an event can trigger financial and other economic difficulties in the financial and real sector, as well as the loss of confidence in a significant part of financial sector. In that sense, events that can provoke systemic risk and problems are sudden or unexpected, and their occurrence is caused by a longer accumulation of inadequate decisions, policies and regulation, etc (Group of Ten, 2001).

The ECB (2009) has defined systemic risk as the risk of spreading financial instability and disrupting financial system functions to the extent were economic growth and development, together with society's well-being are seriously threatened.

Hendricks (2009) has given an alternative definition of systemic risk using natural science, epidemiology and evolutionary biology which also study systemic stability. This approach defines systemic risk as the risk of phase transition from one equilibrium state into another, far less optimal one, characterised by multiple effects of lower intensity, causing disorder and instability and therefore a difficult return to previous equilibrium. As occurrence of systemic risk in economy and financial system, Hendricks emphasizes: bank runs, financial market collapse and the collapse of financial system infrastructure or payment system (Hendricks, 2009).

It is important to emphasize difference between the systemic risk analysed in this paper and the systematic risk as market or undiversifiable risk. Systematic risk has been the subject study in the field of portfolio management theory. The term systemic risk and its formal definition in relation to systematic risk is less known and accepted (Hansen, 2012).

Schwartz (2008) has emphasized that great attention has been given to studying systemic risk in banking sector, while other financial institutions and other market segments have been unduly overlooked. Schwartz found the common factor in defining systemic risk in an event or an occurrence, e.g. economic instability or bankruptcy of a financial institution that may trigger systemic risk, consequently manifested as connected economic events - consequences, also known as the “domino effect”. Consequences mentioned can be financial institutions' bankruptcy, financial market breakdown or something less dramatic like significant losses of financial institutions or price volatility on the financial market. As an example for systemic risk appearance, the author mentions the case of bankruptcy of LTCM hedge fund and the consequent intervention of the FED. In the end, the author defines systemic risk as the risk of extreme growth in cost of capital, its increased volatility or a decrease in availability due to economic shock, market failure or bankruptcy of one or more financial institutions (Schwartz, 2008).

Keeping in mind previously mentioned, as well as all direct and indirect consequences of general and long-term instability of the financial system, the importance of a precise qualitative and quantitative definition of the systemic risk is highlighted.

Methodological approach to measuring systemic risk is a developing field, which is also confirmed by a comprehensive analysis “Survey on systemic risk analytics” conducted by Bisias et al. for the US Department of the Treasury. The aim of analysis was to present measures and systemic risk methodology used until now and to stimulate further research in this field. The authors analysed 31 quantitative measure of systemic risk present in economic and financial literature in order to encourage more precise quantitative measuring and systemic risk management. They divided the taxonomy of systemic risk measurements into taxonomy according to data required, supervisory approach, event and time frame and according to research method. The use of MRS model is also emphasized among different methodologies of measuring systemic risk and financial instability (Bisias et al., 2012).

Hendricks (2009) also considered different approach models to developing systemic risk. He emphasized traditional economic models which evaluate the impact of one institution or one risk on the entire financial system, models based on economic cycles and creating “bubbles” and more recent population and network models. Network models underline that complicated and ambiguous systems are more liable to systemic risk than the more simple and transparent ones, while population models observe financial system as a set of different populations – groups of financial institutions or products. According to the author, basic assumptions for market stability are an encouraging innovative surrounding, as well as a general variety of participants, business policies and strategies, financial instruments, etc. This model implies healthy population where innovation is encouraged and population diversity prevents “herd behaviour” and “bubble” effects (Hendricks, 2009).

In the entire system of measuring and modelling systemic risk, Hansen (2012) has especially emphasized: (1) so-called “tail measures” which measure interdependence in “tails” of returns on capital market (in the papers of Adrian and Brunnermeier in 2011, Acharya et al. in 2010), (2) analysis of potential damages based on the theory of evaluating options and sources of funds of financial institutions, (3) network models and financial institutions' interconnection analysis and (4) dynamic stochastic macroeconomic models based on dynamic stochastic equilibrium models – DSGE models. The MRS model for evaluating financial stress and systemic risk is used, among other, by Ang and Bekaert (2002), Kunovac (2011), Dumičić (2014), etc.

On the other hand, the measures used to capture systemic risk of institutional investors' sector, investment funds especially, are underrepresented. Within the Financial Soundness Indicators – FSI, considered being indicators of financial stability and resilience, not a single one out of 40 indicators directly refers to investment funds or institutional investors. They are included indirectly through two indicators for other financial institutions and through two indicators related to financial market (IMF, 2006). Due to importance which investment funds represent in the financial system, it is necessary and reasonable to significantly re-examine systemic risk and its contribution to financial (in) stability.

The traditional approaches to systemic risk management are limited to a single segment of the financial sector or microprudential approach and their goal is not monitoring entire financial sector stability. Apart from microprudential regulation, other sector based measures for eliminating systemic risk are also present. Those are: deposit insurance system, guarantee funds in insurance or pension funds, guaranteed returns of pension funds and investor protection from investment company's bankruptcy. The comprehensive systemic risk management is included into macroprudential regulation and supervision of the financial system with the aim of preserving financial stability.

After the recent financial crisis, the issue of systemic risk management has been emphasized through several different initiatives and areas of regulatory changes. Some of these initiatives are: additional evaluation, identification and regulation of systemically important financial institutions, banks and insurers (SIFI and G-SIFI), review of “too big to fail” rule, EU initiatives in part of banking union, a single deposit insurance scheme and dealing with bank recovery and resolution. In the part of investment funds in 2014, an initiative has been launched via a consultative document FSB and OICV-IOSCO for evaluation and identification of nonbanking and noninsurance globally important financial institutions (FSB i OICV-IOSCO, 2014). This document and an earlier OFR study has sparked numerous comments and opposing opinions. The comments on the matter emphasize the importance of an analytical approach and a need for further scientific research that would contribute to an adequate evaluation of systemic risk of investment funds and its share in financial (in)stability (see further: SEC, 2014).

Apart from literature which analysed defining, measuring and managing systemic risk, other authors have usually evaluated systemic risk through banking sector, from bank runs, validity and profitability of government interventions, etc. (further in Cerutti et al, 2012, Brown, 2011, Van den End and Tabbæ, 2012, Huang et al, 2011, Krzñar, 2009). Papers that are also represented are papers that evaluate systemic risk and financial market through financial market interconnection, spreading of systemic risk and spill-over risk, as well as fire sales (further in Jotikasthira et al, 2012, Hartmann et al, 2001, Wagner, 2013, Patro et al, 2013, Shleifer and Vishny, 2010). Systemic risk and regulatory changes and government interventions have also been subject of numerous research, new suggestions, as well as reviews of effectiveness of current regulations (further in: Shich and Kim, 2010, Cumming, 2011, Acharya et al, 2010, Anabtawi and Schwarcz, 2011, Tarashev et al., 2010, Acharya, 2009, Galati and Moessner, 2011).

According to the ORF (2013), the papers examining systemic risk and investment funds sector were focused on: asset management sector vulnerability in reaching for yield and herding, redemption risk, financial leverage and bankruptcy risk of particular management company. Transmission channels of systemic risk in the part of fire sales and exposure and connection to creditors, other parties, investors and market participants is also analysed (ORF, 2013).

Investment approach according to “herd behaviour” principle, whether this be a single security or a complete investment strategy, has been emphasized in the papers of Wermers (1999), Choi and Sias (2009), Dasgupta et al. (2011). They determined the existence of portfolio herding in investments of institutional investors and investment funds individually. They demonstrate the intensity of portfolio herding influence on asset prices in the short and long run and motives for such investment behaviour, generally ranging from reputational impact to desire to increase the value of securities above its fundamental value. In their research Edelen (1999) and Coval and Stafford (2006) have pointed to the

influence of redemption risk and net outflows from investment funds onto portfolio reshuffling and the necessity of implementing costly and unprofitable sales.

The following elements which can increase the probability and the influence of fire sales: (a) substantial market and owner concentration, (b) nonliquid markets, (c) reputational risk, (d) trade according to “herd behaviour” principle, financial leverage, (e) transactions with liquidity demands and (f) discrepancy between assets and liabilities (ORF, 2013).

Hau and Lai (2012) and Manconi et al. (2012) research notice the influence of institutional investors and investment funds particularly, on deepening financial crisis by reshuffling its investment portfolio and disinvesting on the financial market.

3. Data and research methodology

The data tested are BAIF UCITS indices for fund of funds of UCITS investment funds. The represent indices of UCITS funds of funds with similar investment strategy. BAIF UCITS indices have been created by the Bloomberg company and in this research the following indices are used: UCITS fund index of mixed funds (BBUFBLNC), UCITS fund index of investment funds with flexible portfolio (BBUFFLEX), UCITS fund index of government or corporate bond funds (BBUFGVCP), UCITS fund index of global equity funds (BBUFGLEQ), UCITS fund index of international equity funds (BBUFINTE), UCITS fund index of emerging markets equity funds (BBUFEQEM) and UCITS fund index of equity growth funds (BBUFGRTH). As indicators representing surroundings of financial market six major stock indices has been taken: S&P 500, NASDAQ Composite, Nikkei 225, FTSE 100, DAX, CAC 40 and Chicago Board Options Exchange Market Volatility Index (VIX index). Individual time series consists of 463 observations in a period from February 4th 2005 to December 13th 2013. Data are collected on weekly bases.

The research methodology in this paper is primarily based on the Markov Regime Switching (MRS) model and also uses a correlational analysis and HFSRI index (*Hedge Fund Systemic Risk Indicator*).

During modelling of particular Markov Regime Switching (MRS) models, the starting point represents the inputs in the form of price indices of the observed UCITS funds, i.e. of chosen stock indices p_t . To each price level in the observed time period t is added a corresponding return calculation using logarithmic transformations in percentages:

$$r_t = 100 * [\log(p_t) - \log(p_{t-1})] \quad (1)$$

In order to deepen the standard index comparison, the existence of a regime within the same time series is assumed. The regimes have common characteristics and are mutually exclusive. The mutual connection of identified regimes is based on Markov chains, or the assumption that every following regime is independent on the previous one. The model observed is based on the existence of two regimes, the first one representing period of expansion characterised by high returns, and the second regime or the period of contraction, where returns are significantly lower. Since MRS model is based on the conclusions derived from the probability theory, the probability of regime change is defined in the following way:

$$p[S_t = j | S_{t-1} = i] = p_{ij} \quad (2)$$

where probability of transition from one regime to another is defined by the occurrence of regime j conditioned by the existence of regime i in time period $t-1$. With the existence of n number of regimes the following relation can be applied:

$$\sum_{j=1}^n p_{ij} = 1, \text{ za } i = 1, \dots, n \quad (3)$$

Since the MRS model is based on the presence of two regimes, expansion and contraction, it is necessary to define two sets of transitional probabilities. Summing up the regime changes probability

functions considering the first order condition of the Markov process (Engel and Hamilton, 1990), the following probabilities arise:

$$\begin{aligned} p[S_t = 1 | S_{t-1} = 1] &= p, \\ p[S_t = 1 | S_{t-1} = 2] &= 1 - p, \\ p[S_t = 2 | S_{t-1} = 2] &= q, \\ p[S_t = 2 | S_{t-1} = 1] &= 1 - q, \end{aligned} \quad (4)$$

where the period of expansion is marked under index 1 and contraction with index 2. Using Markov's first order process, the model ensures homogeneous probability of regime change within the observed sample, while other Markov property defines the system state in time period t as the only factor which influences the state outcome in time period $t+1$.

Aggregating the previously defined properties and functions of regime change probability, a matrix of transitional probabilities is constructed, representing also the first step in estimation of the selected parameters.

$$\begin{bmatrix} p_{00} & p_{01} \\ p_{10} & p_{11} \end{bmatrix} = \begin{bmatrix} P(S_t = 0 | S_{t-1} = 0) & P(S_t = 1 | S_{t-1} = 0) \\ P(S_t = 0 | S_{t-1} = 1) & P(S_t = 1 | S_{t-1} = 1) \end{bmatrix} = \begin{bmatrix} P & 1 - P \\ 1 - Q & Q \end{bmatrix} \quad (5)$$

The following category of evaluated parameters includes the mean values of observed UCITS fund returns (μ) and return volatility in the form of standard deviations (σ). Furthermore, maximum likelihood function using numerical optimization is applied to estimate parameters of the presented models. Required model parameters are derived by solving each of the individual elements or sample mean (μ), standard deviation (σ) and transition probability (p):

$$\hat{\mu}_j = \frac{\sum_{t=1}^T y_t * P\{s_t = j | y_t; \hat{\theta}\}}{\sum_{t=1}^T P\{s_t = j | y_t; \hat{\theta}\}} \quad (6)$$

$$\hat{\sigma}_j^2 = \frac{\sum_{t=1}^T (y_t - \mu_j)^2 * P\{s_t = j | y_t; \hat{\theta}\}}{\sum_{t=1}^T P\{s_t = j | y_t; \hat{\theta}\}} \quad (7)$$

$$\hat{p}_j = T^{-1} \sum_{t=1}^T P\{s_t = j | y_t; \hat{\theta}\} \quad (8)$$

Results of MRS models in this case recognize every return trend change as a threat to detecting new regime and are, therefore it is necessary to apply Hamilton filter. Filtering the values from time series enables regime estimation on the basis of historical observations and requires additional smoothing of the probability functions. The algorithm (Chang-Jin, 1994) used in the process of function smoothing uses previously defined assumptions within the estimation based on the previously recognised period in time $t-1$:

$$\begin{aligned} P(s_t = i, s_{t+1} = j | \tau_t) &= P(s_t = i, s_{t+1} = j, \tau_t) * P(s_{t+1} = j | \tau_t) \\ &= \frac{P(s_t = i, s_{t+1} = j | \tau_t)}{P(s_{t+1} = j | \tau_t)} * P(s_{t+1} = j | \tau_t), \end{aligned} \quad (9)$$

After applying above developed calculations, filtered smoothed probability functions for regime transition are derived from estimated model and additionally compared, with a remark related to critical value threshold. Moreover, every critical probability in the model which is equal or higher than 50% is accepted as a change in the regimes.

4. Results

Based on the hypothesis and methodology applied, the following conclusions are provided.

H1. The UCITS funds returns and the returns of stock indices are characterised through two different regimes: calm and turbulent.

During the calibrating of the MRS model, an assumption of two different regimes, calm and turbulent, was used. In order to confirm assumptions and significance of the identified regimes, it is necessary to

confirm regime during at least one period. Specificities of the turbulent period or crisis period is manifested in different intensity of occurred crisis, which could lead to lower statistical significance of the turbulent regime. In the case of MRS model of all UCITS funds, the calm regime proved to be statistically significant on the significance level of 95%. Analysing stock indices of selected capital markets, with the 90% significance level, the calm regime of all indices once again demonstrates statistical significance, which confirms existence of two regimes.

Characteristics of identified calm regimes of UCITS funds are found in positive returns and lower volatility in relation to the observed turbulent regime. System stability is measured by the probability that the system will, in the forthcoming period, remain in the present regime. As shown in the following table, the probability of remaining in the calm regime of UCITS funds varies from 97% to 99%. Slightly weaker stability is manifested in the turbulent regime. Volatility in a period generates instability and frequent change which leads to probability of remaining in the current regime in an interval from 88% to 97%. The similarity of relations between calm and turbulent regime is noticed during stock market analysis as well.

Common characteristics of certain regimes of UCITS funds can be observed through regime duration. Moreover, considering the regime duration of all variables, the calm regime has been confirmed as dominant one. It is important to emphasize the connection between regime duration and system stability in the form of proportional connection; in other words, the longer is the regime lasts, the probability it will last longer in the following period is higher.

Table 1 Model results

Index	Calm regime					Turbulent regime				
	Return	Volatility	p-value	Duration	Stability	Return	Volatility	p-value	Duration	Stability
UCITS funds										
BLNC	0.18	0.08	0.03	52	0.98	(0.67)	0.42	0.11	11	0.91
EQEM	0.48	0.15	0.00	31	0.97	(1.19)	0.64	0.06	9	0.88
FLEX	0.18	0.07	0.01	99	0.99	(0.48)	0.33	0.15	22	0.95
GLEQ	0.37	0.16	0.02	29	0.97	(0.68)	0.39	0.08	10	0.90
GRTH	0.25	0.10	0.01	69	0.99	(1.05)	0.52	0.05	11	0.91
GVCP	0.13	0.06	0.04	104	0.99	(0.22)	0.22	0.31	33	0.97
INTE	0.25	0.12	0.04	78	0.99	(0.87)	0.71	0.22	21	0.95
Stock markets										
CAC	0.21	0.12	0.07	107	0.99	(1.13)	0.78	0.15	18	0.94
DAX	0.35	0.12	0.00	127	0.99	(1.25)	1.05	0.23	15	0.93
FTSE	0.21	0.09	0.03	99	0.99	(0.84)	0.74	0.26	15	0.93
NASDAQ	0.37	0.11	0.00	67	0.99	(0.80)	0.59	0.17	15	0.93
NIKKEI	0.22	0.13	0.09	60	0.98	(1.62)	1.45	0.26	5	0.81
S&P	0.26	0.09	0.00	70	0.99	(0.47)	0.45	0.30	19	0.95
VIX	0.02	0.02	0.25	13	0.92	(0.01)	0.01	0.12	6	0.84

Source: author's calculations

As previously mentioned, calm and turbulent regimes have been identified in case of both UCITS funds, as well as in the stock indices.

The additional analysis has been conducted in the form of robustness tests based on the correlation of data series observed. The results of UCITS funds correlation take on the value of minimal correlation of 0.69 and maximum of 0.97. High level of correlation is also an indicator of robustness.

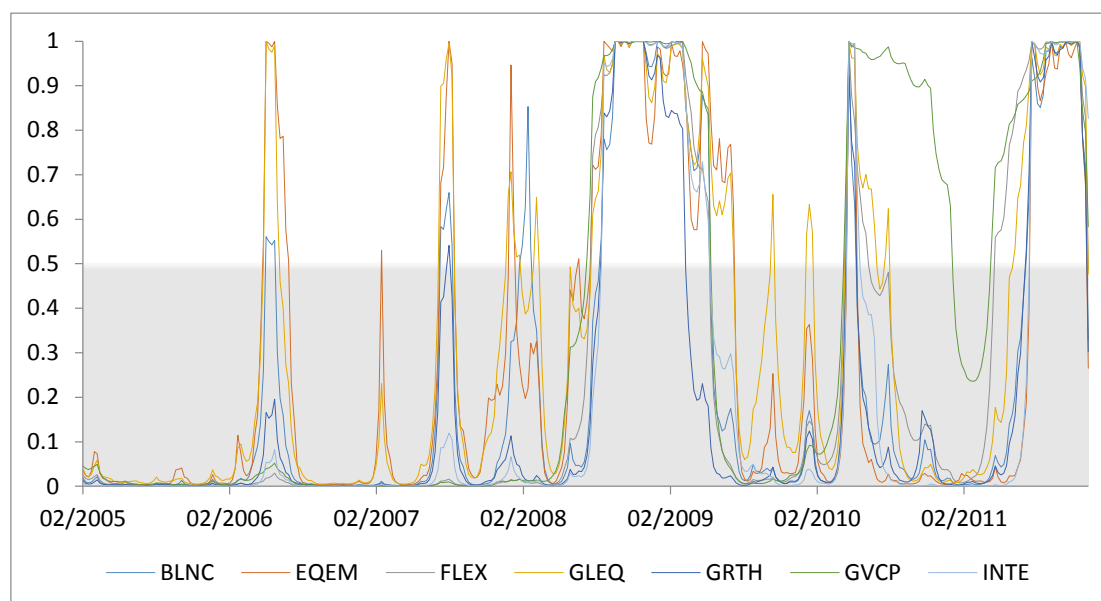
H2. In returns of different types of UCITS funds, systemic risk have been emphasized by overlaps in regime occurrences.

Observing seven different UCITS fund indices (BLNC, EQEM, FLEX, GLEQ, GRTH, GVCP and INTE), common probabilities of certain regime occurrence are identified as systemic risk. In other

words, if there are common movements of observed variables, in terms of transitional probabilities, it is possible to confirm the presence of systemic risk.

Graphical representation of turbulent regime probability occurrence of the observed UCITS funds follows below. Common characteristics of all calm, or turbulent regimes, have been noticed, which leads to conclusion of systemic risk presence during movements of variables analysed in the particular time period. Shaded area shows transitional values higher than 50% which confirms status change or occurrence of turbulent regime. Since UCITS indices shown differ according to structure of portfolio, the absence of systemic risk would mean independent trends of transitional probability, regardless of other variables movements.

Chart 1 Probabilities of occurrence of turbulent regime



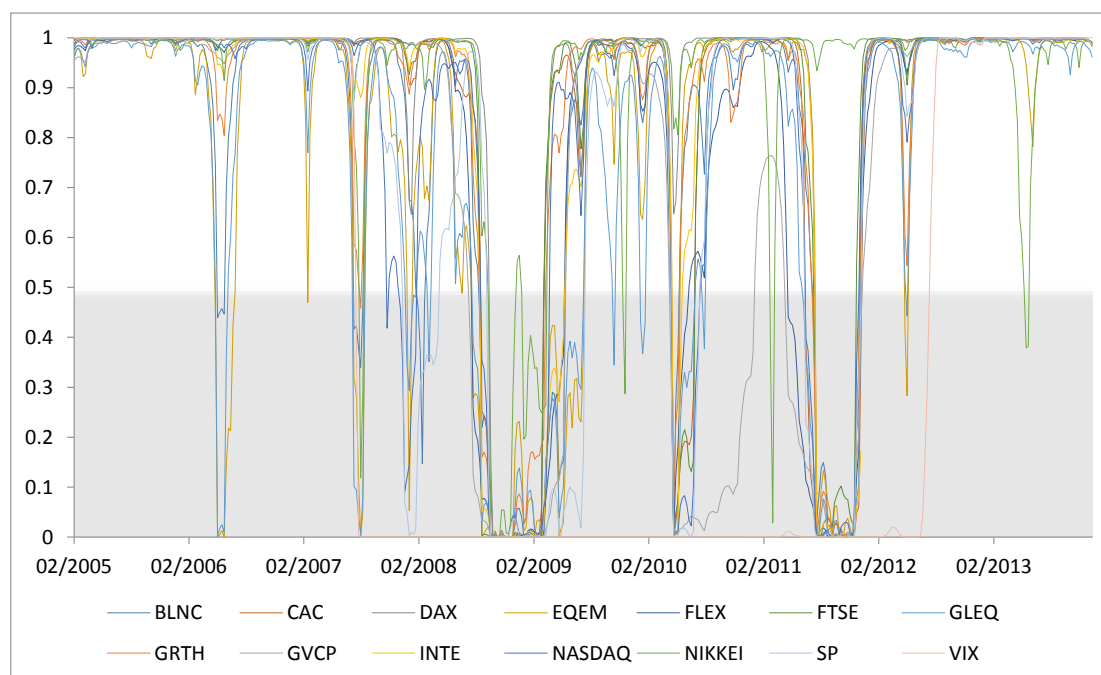
Source: author's calculations

The probability of turbulent regime occurrence clearly shows that transitional regime probabilities of all UCITS funds move according to predefined common pattern. It is important to emphasize that common trends of observed variables are noticed in both regimes, which leads to conclusion that systemic risk is present in all observed UCITS funds, regardless the state the market is currently in.

H3. Different types of UCITS investment funds, according to investment strategy, do not show resilience towards systemic risk and systemic interconnection of returns of investment funds and stock indices.

The hypothesis re-examines the presence of systemic risk through analysing several different types of investment funds according to structure and investment strategy presented through analysed UCITS funds indices. The aim of this hypothesis is to confirm the presence of systemic risk regardless the conservative UCITS funds investment strategy and the diversity of their investment strategies and types.

As in previous cases, systemic risk is manifested as a strong component for generating regime transition probability and affiliation to certain regime. Differences in conservative strategies or type of UCITS funds do not result in systemic risk resilience, which can be concluded on the basis of common characteristics of models in calm and turbulent period.

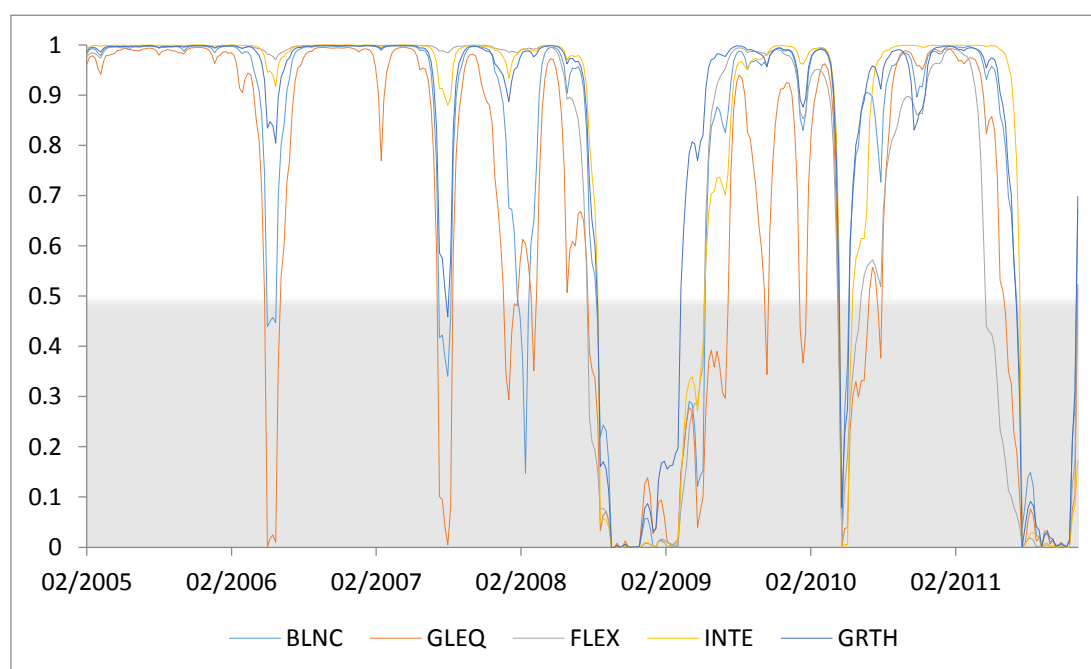
Chart 2 Transitional probabilities of occurrence of calm regime of selected UCITS indices

Source: author's calculations

Additional confirmation of systemic risk presence can be found when observing HFSRI index (*Hedge Fund Systemic Risk Indicator*), which represents the sum of all probabilities of turbulent period occurrence higher than 50%. HFSRI index results are measured in absolute amounts and as relative share of a maximum value of the index itself. Therefore, HFSRI index reflects the value for BLNC 66 (19%), FLEX 74 (21%), GLEQ 92 (26%), GVCP 107 (30%) and INTE 59 (17%). Common features or systemic impact, have been confirmed by the HFSRI index moving in an interval difference of 10% in total maximum index value.

H4. Systemic risk and regime occurrence among indices of UCITS investment funds overlap with movements in returns of chosen stock indices and volatility index (VIX index).

Considering the confirmed presence of systemic risk in the observed return series of UCITS funds, the observations of occurrence and duration of systemic risk in UCITS funds and capital market is compared. Identifying correlation of movements of UCITS transitional values and capital market, systemic risk gets an additional level of impact. Graphical chart below representing transitional values of UCITS funds and selected stock indices show strong component of common trends, both in calm and in turbulent regime, which indicates a strong systemic component and systemic risk presence.

Chart 3 Transitional probabilities of UCITS funds and stock indices

Source: author's calculations

Additional emphasis on systemic risk presence is seen in observing VIX indices as measure of volatility. In fact, VIX index as a measure of expected market volatility also demonstrates certain level of influence and systemic risk presence through volatility intensity. This observation emphasizes the existence of systemic influence even before it can be noticed in the market. By identifying two regimes and its common trends with UCITS fund indices and selected stock indices, systemic risk takes on new dimension that starts with expectations on common risk characteristics. The identified process is based on the occurrence of systemic impact during the very expectations and is extended towards realised movements of observed UCITS funds and of selected stock indices as well.

5. Discussion and conclusion

Investment funds are a crucial segment as both investors on the financial market, institutional investors, and as an investment opportunity for retail investors and a form of long term pension savings. According to the volume of funds and investment share in particular category of financial instruments, they are extremely important in maintaining market mechanisms and financial market stability. It is exactly the periods of financial crisis that appear to be the time when investment funds, regardless of their, usually, long term investment policy, generate substantial systemic risk. Generating systemic risk alone is defined by financial market situation, some significant event, but also of investment funds characteristics in part of risk sharing and the possibility of disinvesting.

Research in this paper uses MRS model methodology, as one of methodologies used to measure systemic risk, and show presence of systemic risk and systemic components in trends and regime changes in all observed investment funds indices. Regardless various investment strategies or investment fund types, systemic trends in all UCITS fund indices are identified. When these trends are compared to stock indices and VIX index, the presence of systemic component and trend compatibility both in appearance, duration and regime change is observed.

Paper results show one of several methods and approaches to estimated systemic risk in investment funds business activities and trends on the financial market. The topic of systemic risk in the segment of investment funds is underrepresented compared to banking sector. This shortcoming is present in

the conducted research, financial stability indicators and in initiatives of supranational associations and regulatory institutions. This topic definitely requires additional attention from both researchers and experts due to the assets under management and the fact that this continues to the importance of the social issues such as pension savings and financial market stability.

An important issue that also arises from this research is data availability and the necessity for further research. The changes in this part can be seen in increasing the number of funds or investment funds indices analysed, including qualitative data, such as supervisory body's decisions, relevant market events and contributions to creating macroprudential measures in order to decrease accumulated systemic imbalances and, in the end, curbing the effects of systemic risk appearance.

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