



Management of Investment Funds Financial Fragility

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ABSTRACT

The aim of the research is to characterize the main factors of investment funds financial fragility (concentration, interconnectedness, yield search, homogeneous strategies, procyclical activity, low substitutability, growth of leverage, low liquidity) in the Euro area. Correlation coefficients with different strategies and the stock index EURO STOXX 50 were used to check the presence of procyclicality (market behavior and homogeneity of investment funds strategies) on the example of European hedge funds. In article was proposed to calculate a financial fragility index as a simple average of a leverage multiplier, a liquidity mismatch and an indicator of the interconnectedness of funds with other financial institutions. The correlation and regression analysis were applied to identify statistical relationships between the level of financial fragility of different types of investment funds, as well as with the values of Composite Indicator of Systemic Stress (CISS) in the Euro area and the return of stock index EURO STOXX50. The results of empirical calculations showed that at the present stage, these investment institutions are characterized by a generally acceptable level of sensitivity to market fluctuations. The study found reverse behavior of the equity funds financial fragility index in relation to the situation on the stock market and mainly statistical insignificance of the financial fragility index correlation of different types of investment funds, as well as with CISS. The results also indicated that the level of homogeneity of hedge funds and their procyclical behavior in relation to trends in the stock market increases during crisis periods.

INTRODUCTION

Institutions of collective investment schemes play an important role in the institutional structure of investors in the securities and derivatives market. This type of investment institution operates as a financial intermediary that allows different types of investors, depending on their level of financial literacy and aversion to risk, to take advantage of the ability to generate additional income on the basis of indirect investments in both classical types of securities and complex investment products of financial engineering.

Current collective investment practices require a network of institutions that determine the specifics of this type of financial activity. Thus, a feature of this investment institutions is the existence of asset managers, who, for appropriate remuneration, manage investment funds on the basis of some investment policy. An asset manager acts as a fiduciary agent (Laurent and Neri, 2015, p. 22; Roncalli and Weisang, 2015, p. 8) and its assets are separated from the assets of the funds, and therefore the risk of asset managers' insolvent does not apply to investors.

According to EU law the competent authorities of the investment company's home Member State shall not grant authorization to an investment company that has not designated a management company unless the investment company has a sufficient initial capital of at least EUR 300 000 (European Parliament and of the Council, 2009). Furthermore, according to Directive 2011/61/EU Member States of EU shall require that the managers of alternative investment funds (AIFMs) which is an internally managed alternative investment funds has an initial capital of at least EUR 300 000 (European Parliament and of the Council, 2011).

The main task of portfolio managers is to develop and implement such a format of investment strategy that would ensure the growth of the welfare of investment fund's investors, i.e. the growth of the value of the fund's net assets. Moreover, the achievement of this goal will have a positive impact on the amount of remuneration of asset managers for the effective management of financial resources of the investment fund. However, the portfolio manager's desire to generate high returns causes a decrease in their aversion to risk and, as a consequence, an increase more risky financial instruments in the structure of the investment fund assets, which leads to an increase in fragility of investment funds, i.e. the growth of their vulnerability to probable shocks, which can affect the functioning of the funds and the financial instruments market stability negatively.

On the other hand, the latest global financial crisis has exposed the main weaknesses in the functioning of financial institutions, which led to a significant increase in regulations, which to some extent is already inflationary, especially in the banking sector. As a result, regulatory arbitrage has intensified, i.e. migration of financial capital to less regulated sectors of the financial system, which was reflected in the formation of the so-called shadow banking sector. At the level of the European Union, regulatory requirements for collective investment schemes have been updated and expanded, but their scale is much smaller, that affected the increase in the activity of these financial institutions, which are often defined as the main component of shadow banking.

In the current situation, there is a question of a possible increase in the financial fragility of investment funds and the need to take it into account by portfolio managers in the management of investments. Institutions of collective investment schemes and the financial instruments market are closely linked, despite the dominant role securities and derivatives in the assets of funds. Therefore, the destabilization of funds is reflected in the disruption of the stable functioning of the market and vice versa, as well as in the implementation of systemic risks, that can lead to a negative impact on the real sector of the economy (fig. 1).

In case of shock, which may be caused by events both in the financial instruments market, other financial institutions, and the real economy or other events (for example, political ones), investors increase the number of claims for redemption of their shares in open-type funds, which are obliged to carry out their redemption on a permanent basis. Given that the prices of financial instruments in the market will fall, so the value of the fund's net assets will decrease, and for the first investors-sellers of the fund's shares the redemption price will be higher, and therefore the effect of the first mover advantage acts, which encourages investors to present their shares for sale sooner.

Financial fragility of corporate bond funds in empirical aspect was investigated in research Goldstein, Jiang and Ng (2017), Hasik (2018) however, the definition of financial fragility was not defined. They showed that corporate bond funds tend to have greater sensitivity of outflows to bad performance when they have more illiquid assets and when the overall market illiquidity is high. These results point to the possibility of fragility in the fast-growing corporate bond market. The illiquidity of corporate bonds may generate a first-mover advantage among investors in corporate bond funds, amplifying their response to bad performance. Parlato (2016) presented a general equilibrium model of money market funds (MMFs) to study how sponsor support affects the industry's fragility and regulation. Liu and Mello (2011) substantiated that the fragile nature of the capital structure of hedge funds, combined with low market liquidity, creates a risk of coordination in redemptions among hedge fund investors that severely limits hedge funds' arbitrage capabilities. Chen, Goldstein and Jiang (2010) and Mentel and Horvathova (2016) documented evidence that strategic complementarities generate financial fragility and demonstrate the vulnerability of open-end financial institutions. Furthermore, some factors of investment funds financial fragility were the subject of study in research papers.

Timmer (2018) based on security-level data from the German Microdatabase Securities Holdings Statistics showed, that banks and investment funds respond in a procyclical manner to past security-specific holding period returns. In contrast, insurance companies and pension funds act countercyclically. Racicot and Théoret (2016) tracked the behavior of the cross-sectional dispersions of hedge fund strategies' returns, market betas and alphas over the business cycle. Casavecchia (2016) documented that a manager's decision to trade with (against) the herd decreases (increases) significantly investors' willingness to redeem capital from underperforming funds. Celiker, Chowdhury and Sonaer (2015) also found that mutual funds herd in industries. Cui, Gebka and Kallinterakis (2019) provided the investigation of herding among closed-end fund investors, drawing on the US closed-end fund market for the 1992–2016 period and results suggested closed-end fund investors herd significantly, with their herding being mainly driven by non-fundamentals. Deng, Hung and Qiao (2018) showed that mutual fund herding amplifies stock price crash risk. Fang, Shen and Lee (2017) found positive herding effects in different types of funds during recessionary periods, whereas they have showed evidence of negative herding behavior in most types of funds during expansionary periods (using monthly data in a Markov-switching cross-sectional absolute deviation (CSAD) model to reveal the existence of dynamic herding behavior by US equity fund managers in the stock market). Jiao and Ye (2014) documented strong evidence that mutual funds herd into or out of stocks following the herd of hedge funds: mutual funds' herding measure is positively related to last quarter's hedge fund herding.

Qureshi *et al.* (2017) found, that equity funds follow the market volatility positively, suggesting positive feedback trading (momentum) behavior. On the other hand, balanced funds follow market volatility negatively and exhibit negative feedback trading behavior (contrarian behavior). As stated by FSB (2017) and US Office of Financial Research (OFR, 2013) leverage is considered to be the key factors of vulnerability of investment funds to financial shocks. According to ESRB (2016), leverage strengthens the financial cycle and reduces the stability of market participants. In one of the most well-known pre-crisis research on hedge funds (Garbaravicius and Dierick, 2005), it is noted that with excessive leverage, even small price fluctuations can increase the actions of hedge funds to eliminate their leveraged positions to fulfill margin calls, potentially leading to fluctuations in different markets. Van Echoud *et al.* (2010, p. 32) associated the procyclical behavior of hedge funds with the use of leverage and the need to deleverage during the period of falling prices. In addition, leverage increases the impact of other risks (liquidity, counterparties) in the investment funds activities (Agheorghiesei, Anton and Airinei, 2018). Investment funds can generate systemic risks (IMF, 2015; Lehecka and Ubl, 2015; Mentel *et al.*, 2016), strengthen them and act as a transmission channel (Roncalli and Weisang, 2015, p. 8; Lopez, Markwardt and Savard, 2016, p. 1). They also affect the stability of other financial institutions based on mutual exposures (for example, insurance companies and banks have investment fund's units in their portfolios, etc.), i.e.

the counterparty's risk is realized. The financial instruments market and other financial institutions can also be channels of transfer of realized systemic risk to the institutions of collective investment schemes in the real sector of the economy.

In research of IMF (2015, pp. 104-105), confirms the impact of investment funds inflows on the price dynamics of the market, especially in less liquid markets in developing countries. In emerging market, the negative price effects from sell-offs tend to be larger than the positive price effects from purchases. Doyle et al. (2016) investigated features of shadow banking in the euro area, focusing on investment funds. In this research showed that vulnerabilities within the investment fund sector are growing and links to the wider financial system and real economy have strengthened (using three key metrics for each investment fund type: size, balance sheet leverage and liquidity mismatch). These researches show the importance of investment funds financial fragility in the functioning of the financial system and the need to identify and analyze the key factors of investment funds financial fragility, which further are advisable to take into account by portfolio managers in the management of investment funds.

2. METHODOLOGY AND DATA

Characterization of the main factors of investment funds financial fragility was carried out on the basis of dynamic-structural statistical analysis. The input information for the calculations is the data about investment funds of the Euro area (as a whole), was obtained from the statistical data warehouse of the European Central Bank. Correlation coefficients (in particular, Kendall rank correlation between the values of monthly logarithmic return of indices) with different strategies and the stock index EURO STOXX 50 were used to check the presence of procyclicality of market behavior and homogeneity of investment funds strategies on the example of European hedge funds. The appropriateness of using the Kendall rank correlation coefficients in the analysis of investment funds (in particular, hedge funds) is justified in research papers ECB (2005, pp. 28–30; 2007, pp. 49–53). The European hedge funds indices, which are developed by Eurekahedge, cover almost 23 thousand funds (for comparison, the base of Barclays for the calculation of hedge funds indices includes 5.3 thousand funds) are used for calculations. The leverage multiplier of investment funds is calculated based on the approach of Doyle et al. (2016, p. 16), as the ratio of funds total assets to the shares and units issued by the investment funds.

The approach proposed by Doyle et al. (2016, p. 16) is also used for calculating the level of liquidity mismatch of investment funds, but with certain adjustments. Thus, the liquidity gap indicator (liquidity mismatch) is calculated as the ratio of the shares and units issued by the investment funds to their liquid assets. Liquid assets include government debt securities of Euro area issuers (Doyle et al. (2016) suggest to include also other debt securities with maturity up to 1 year, but it is more correct to include only such instruments with an investment rating, but public aggregated data in this context in the statistical database of the ECB are not available), shares that are listed on the exchange (Doyle et al. (2016) offer all equity shares, however, in our opinion, liquid securities are instruments that can be sold in an organized market). I propose to calculate a financial fragility index (FFI) to observe the level of investment funds fragility on the basis of a simple average of several indicators, namely the leverage multiplier (FL – financial leverage), the liquidity mismatch (LM), as well as the indicator of the interconnectedness of funds with other financial institutions (I) as a ratio of investments in securities issued by the Euro area financial institutions to total assets of investment funds:

$$FFI = \frac{FL+LM+I}{3} \quad (1)$$

Normalization of indicators was carried out to ensure the compatibility of the data using the cumulative density function (CDF). Given the availability of data, the index was calculated on a quarterly basis. In addition, the correlation and regression analysis were applied to identify statistical relationships between the level of financial fragility of different types of investment funds (based on the criterion of the applied investment policy), as well as with the values of Composite Indicator of Systemic Stress in the Euro area (CISS, equal weights) and the return of stock index EURO STOXX50.

3. RESULTS

The concentration of certain types of investors in the financial instruments market as a factor of financial fragility can lead to an increase in systemic risk (with a significant share of other investors). Regarding the asset management companies, this sector to some extent is concentrated although much less than the banking system. Thus, at the end of 2017, the share of the largest asset managers (CR15) in the global dimension was about 37% of the total assets in the collective investment schemes sector (table 1). Each of the 15 largest asset managers has assets under management of more than 1 trillion USD, of which 6 asset managers belong to Europe (5 to the Euro area).

Table 1. The world's largest asset managers ranking (2017)

No	Asset manager	Country	Asset under management (AuM), billion USD	Market share in the global asset management sector, %
1	BlackRock	US	6288,195	6,7
2	Vanguard Group	US	4940,350	5,3
3	State Street Global	US	2781,693	3,0
4	Fidelity Investments	US	2448,807	2,6
5	Allianz Group	Germany	2358,037	2,5
6	J.P. Morgan Chase	US	2034,000	2,2
7	Bank of New York Mellon	US	1892,941	2,0
8	Capital Group	US	1778,134	1,9
9	AXA Group	France	1731,232	1,8
10	AMUNDI	France	1709,475	1,8
11	Goldman Sachs Group	US	1494,000	1,6
12	Deutsche Bank	Germany	1453,321	1,5
13	BNP Paribas	France	1432,968	1,5
14	Prudential Financial	US	1393,628	1,5
15	Legal & General Group	Great Britain	1333,162	1,4
	TOP-15		35069,943	37,4
	Total global assets under management		93828	100

Source: prepared by Author according to data Willis Towers Watson (2018)

Asset managers are mainly associated with banking institutions or insurance companies. Thus, among the 5 largest asset managers in the Euro area, two have ownership relations with insurance groups (Allianz Group, AXA Group), and three are with banking groups (Amundi as part of Credit Agricole, Deutsche Bank, BNP Paribas). On the one hand, the relationship between asset managers and investment funds does not provide the transfer of risks from funds to asset managers,

whereas the asset managers only perform agency functions, and therefore their corporate relationship should not lead to the contagion effect in market instability. However, on the other hand, revenues from the asset management constitute a certain share in the profits of the banking or insurance groups (tab. 2), and therefore their shortfall will negatively affect the financial condition of these institutions, which may have systemic consequences for the market due to the fall in stock prices of banks and insurance companies, and therefore it might be important to take into account the cross-institutional impact of asset managers corporate relationship.

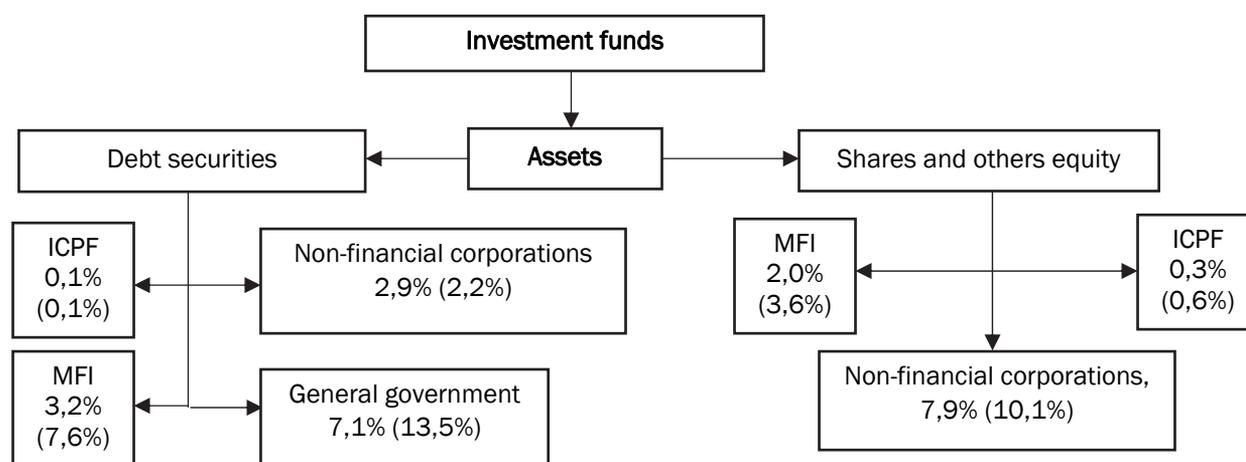
Table 2. Income (loss) before income taxes of banking and insurance group from asset management (2018)

Group	Income (loss) before income taxes, million euro		Share of income from asset management in total income, %
	Total	from asset management	
Allianz Group	10399	2515	24,19
Credit Agricole Group	10123	1182	11,68
Deutsche Bank	1330	367	27,59

Source: prepared by Author according to the financial statements of financial institutions

Data on the structure of investment funds clients indicate a significant interconnectedness of the investment funds within the financial system (which increases financial fragility and systemic risk, including the possible contagion effect). Thus, according to EFAMA (2018, p. 5), the share of institutional investors among the owners of investment fund shares in Europe was 71%. Among institutional investors, pension funds dominate – 28% (of the total investment shares owned by institutional investors) and insurance companies – 25% (the end of 2016). In addition, the interconnectedness with other financial institutions can be determined by analyzing the asset structure of investment funds (fig. 2). In the Euro area at the end of 2018, investments in securities of European issuers account for 41.3% of the total assets of investment funds, and their structure (relative to equity) is dominated by instruments issued by non-financial corporations (10.1% of total assets), and the debt securities in assets is dominated by government financial instruments. Compared to 2008, the interconnectedness with financial institutions decreased both in the stock and other non-fixed income instruments markets and in the debt securities markets.

Figure 2. Structure of the Euro area investment funds investments in securities of European issuers (2018Q4, in parentheses – 2008Q4)



Source: prepared by Author according to the ECB data. The share of investments in securities of European counterparties in the total assets of investment funds of all counterparties, regardless of geographical location. MFI – monetary financial institutions, ICPF – insurance companies and pension funds

The change in the structure of capital allocation is explained by the search for yield and this investment direction also leads to an increase in high-risk investments and as a result to greater investment funds financial fragility. This phenomenon is generally caused not only by low interest rates in the European markets, but also by the specifics of asset management. The manager's desire to make a large profit reduces his risk aversion and leads to an increase of investment in more risky instruments, the price of which is growing currently in the market (momentum strategy), which stimulates increased market procyclicality (contributing to the built-up of price "bubbles"), and such behavior of most portfolio managers leads to homogeneity strategies (herd behavior). Thus, the probability of potentially strong market instability increases through the activation of several catalysts for the investment funds fragility at the same time (fig. 1).

To check the presence of procyclicality of market behavior and homogeneity of investment fund strategies on the example of European hedge funds, I calculate the correlation coefficients of hedge fund indices with different strategies and with the stock index EURO STOXX 50, using the following indices:

- (1) Eurekahedge Europe Arbitrage Hedge Fund Index – EAHFI;
- (2) Eurekahedge Europe Long Short Equities Hedge Fund Index – ELSEHFI;
- (3) Eurekahedge Europe Multi-Strategy Hedge Fund Index – EMSHFI;
- (4) Eurekahedge Europe Event Driven Hedge Fund Index – EEDHFI.

Hedge funds for research are chosen taking into account their interpretation as institutions that use strategies that are mainly opposite to the main trends in the market (Garbaravicius and Dierick, 2005, p. 25). The Kendall rank correlation coefficients were calculated in the context of 3-time horizons – pre-crisis (2000–2006), crisis (2007–2012), post-crisis (2013–2018).

Table 3. Correlation matrix of hedge fund indices and stock index EURO STOXX50

	EAHFI	EEDHFI	ELSEHFI	EMSHFI	EUROSTOXX50
<i>Pre-crisis period (2000–2006)</i>					
EAHFI		0,0568	0,0493	0,1606	-0,0011
<i>p-value</i>		0,4443	0,5064	0,0305	0,9877
EEDHFI	0,0568		0,5324	0,3523	0,2260
<i>p-value</i>	0,4443		0,0000	0,0000	0,0023
ELSEHFI	0,0493	0,5324		0,3448	0,4320
<i>p-value</i>	0,5064	0,0000		0,0000	0,0023
EMSHFI	0,1606	0,3523	0,3448		0,1773
<i>p-value</i>	0,0305	0,0000	0,0000		0,0170
EUROSTOXX50	-0,0011	0,2260	0,4320	0,1773	
<i>p-value</i>	0,9877	0,0023	0,0023	0,0170	
<i>Crisis period (2007–2012)</i>					
EAHFI		0,4125	0,3730	0,3247	0,2563
<i>p-value</i>		0,0000	0,0000	0,0001	0,0016
EEDHFI	0,4125		0,7948	0,6531	0,5123
<i>p-value</i>	0,0000		0,0000	0,0000	0,0000
ELSEHFI	0,3730	0,7948		0,7264	0,5710
<i>p-value</i>	0,0000	0,0000		0,0000	0,0000
EMSHFI	0,3247	0,6531	0,7264		0,5034
<i>p-value</i>	0,0001	0,0000	0,0000		0,0000
EUROSTOXX50	0,2563	0,5123	0,5710	0,5034	

<i>p-value</i>	0,0016	0,0000	0,0000	0,0000
<i>Post-crisis period (2013–2018)</i>				
EAHFI		0,2316	0,2848	0,2848
<i>p-value</i>		0,0040	0,0004	0,0004
EEDHFI	0,2316		0,5180	0,5102
<i>p-value</i>	0,0040		0,0000	0,0000
ELSEHFI	0,2848	0,5180		0,5994
<i>p-value</i>	0,0004	0,0000		0,0000
EMSHFI	0,2848	0,5102	0,5994	
<i>p-value</i>	0,0004	0,0000	0,0000	
EUROSTOXX50	0,2692	0,3662	0,6354	0,5947
<i>p-value</i>	0,0008	0,0000	0,0000	0,0000

Source: prepared by Author.

There was a slight correlation between the hedge funds indices and between some indices was statistically insignificant in the pre-crisis period. During the crisis period, the correlation increased (ranging from 0.26 to 0.79) and was statistically significant between all indices. During the last time horizon, the correlation between hedge fund indices as well as with the stock index is statistically significant, but slightly decreased (range from 0.23 to 0.63). Based on the calculated correlations, the following conclusions can be drawn: (1) during the crisis and post-crisis period, there is an increase in the use of homogeneous investment strategies, which is confirmed by the increase in the correlation between the various hedge fund indices, (2) the procyclical activity of hedge funds can be most clearly observed in the crisis period, i.e. the negative phenomena during the market disruption are mutually reflected in the securities market and in the hedge fund activities. Another aspect of the study of the investment funds fragility and its negative impact in the financial instruments market is the level of substitutability, that is, how wide is the scope of collective investment schemes in relation to the provision of services.

I propose to define three types of substitutability (based on the types of funds according to the investment policy criterion) – intraspecies (investments in another fund of the same type), interspecies (investments in another type of funds with a similar strategy) and cross-border (investments in funds of the same type or another type with a similar strategy from other countries). As it was defined earlier, the portfolio managers apply a similar investment strategy, therefore the funds have a high level of interspecies substitutability for investors. In addition, the lack of a monopoly position of separate funds in the market, their significant number as a whole in the Euro area, as well as the low level of concentration among asset management companies indicates a high level of substitutability of different types in this sector, which reduces its sensitivity to financial shocks. In the regional context, the scope of investment funds in the Euro area is rather fragmented (table 4).

Table 4. Structure of the number of open-end investment funds in the Euro area (2019Q1)

Country	Total	Equity funds	Bond funds	Mixed funds	Money market funds	Other funds
Austria	1602	267	516	709	0	110
Belgium	701	211	52	78	9	351
Cyprus	68	7	8	31	0	22
Finland	401	203	95	68	5	30
France	10651	1751	1052	3036	126	4686
Germany	6188	921	1031	3136	16	1084
Greece	177	57	64	41	14	1

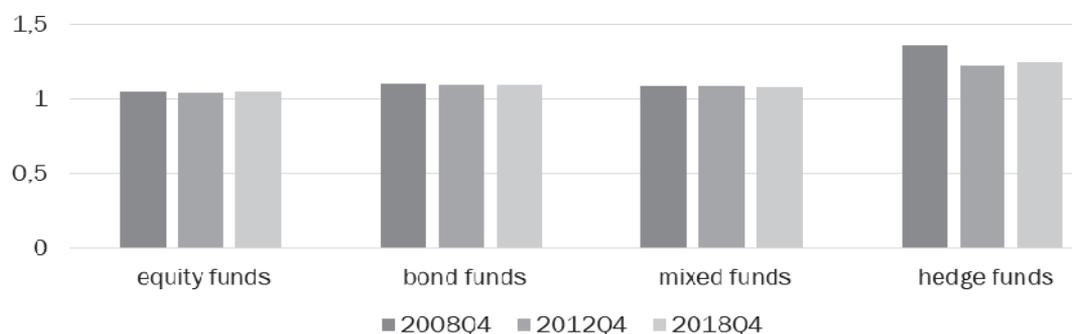
Ireland	7450	2243	1077	700	117	3313
Italy	888	91	205	245	5	342
Luxembourg	14917	4070	3140	3959	242	3506
Malta	133	31	26	19	1	56
Netherlands	942	379	233	88	0	242
Portugal	136	42	25	35	2	32
Slovakia	90	8	24	51	0	7
Slovenia	98	69	10	15	3	1
Spain	2618	995	675	532	35	381

Source: prepared by Author according to International Investment Funds Association (2019)

The lowest level of intraspecies substitutability is observed in several countries regarding money market funds. Money market funds are not available in Austria, Slovakia, the Netherlands, Cyprus, but investments in this type of funds can be partially replaced by investments in bond funds (interspecies substitutability) and, in addition, the presence of a single passport allows investment funds to operate in different EU countries, i.e. cross-border substitutability is possible. An important factor that affects the investment funds fragility is the level of leverage, namely the use of debt instruments and derivatives (synthetic leverage) to funding active operations. A classic example of the financial collapse of leveraged collective investment schemes is the LTCM (Long-Term Capital Management) hedge fund, which used arbitrage strategies (based on models of Nobel laureate R. Merton) in the presence of high leverage. In 1998 as a result of the Russian debt crisis, this institution suffered significant losses and to avoid significant financial turmoil on September 23, 1998, 14 major financial institutions (including Barclays, Chase Manhattan, Goldman Sachs, Merrill Lynch, Deutsche Bank and others) signed an agreement with LTCM on assistance in exchange for 90% of the fund's shares. On September 21, 1998 this fund's financial leverage exceeded 100:1 (Perez, 2011, p. 192).

The collapse of two Bear Stearns funds in 2007 showed that leveraged funds can encourage other financial intermediaries (in particular banks) to support them in a stressful situation through reputational risks (FSB, 2017, p. 24). Based on the calculation of the leverage multiplier for the Euro area investment funds, we can observe (Fig. 3) that most leveraged (dynamics is further growing) and financial fragile in this aspect are hedge funds, leverage which ranged from 1.36 to 1.25 during the studied time horizon. Equity and bond funds use leverage at a low level (a ratio of 1 indicates that the funds do not use financial leverage).

Figure 3. The dynamics of the investment funds leverage multiplier in the Euro area

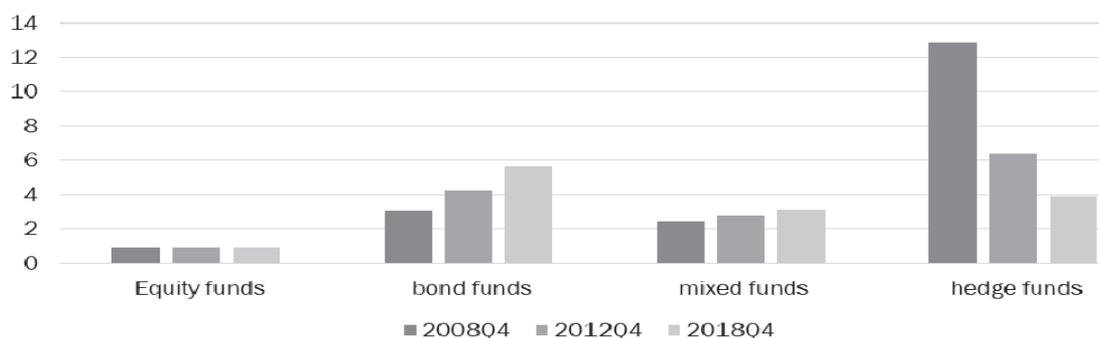


Source: prepared by Author.

In the world practice, leverage is also used in the activities of ETFs (exchange-traded funds), in particular, in Japan the share of assets of leveraged ETFs in the market of this type of investment funds is about 6%, but the volume of transactions is about 80% (Okabe *et al.*, 2016, p. 2). However, the leverage multiplier does not fully reflect the realities of the role of this phenomenon in asset management, whereas there is no publicly available data on synthetic leverage, which arises based on the use of derivatives, especially off-balance sheet ones. For example, according to the DNB (Central Bank of the Netherlands) 54% of alternative investment funds in this country use synthetic leverage (ECB, 2016, p. 126).

Another indicator that determines the level of the investment funds fragility is their liquidity mismatch, which is especially important for open-end funds, which are required to redeem issued financial instruments at the request of investors. Just the lack of liquidity can lead to an increase in the number of claims for redemption and the appearance of run on the fund. As it is evidenced by the results of calculations (Fig. 4), the largest liquidity mismatch is typical for hedge funds, but there is a positive trend in a significant decrease in such a gap compared to 2008 (2018 – 3.96; 2012 – 6.37; 2008 – 12.93). The growing dynamics of the liquidity mismatch during the analyzed time horizon is typical for debt funds, which may be caused by an increase in investments in corporate debt securities as a result of the search for yield. The least fragile regarding the liquidity indicator are equity funds, which liquid assets (in 2016) were almost equal to the value of issued own financial instruments.

Figure 4. Dynamics of the investment funds liquidity mismatch in the Euro area



Source: prepared by Author.

To observe the level of investment funds fragility I propose to calculate a synthetic financial fragility index (FFI – financial fragility index). Given the multifaceted nature of the functioning of investment funds and the difference between the values of the fragility indicators for the various funds, the financial fragility index is counted separately for different types of investment funds, depending on the adopted approach to investment policy. This is confirmed by the data on the correlation of the calculated FFI for certain types of funds (tab. 5) – only the correlation of FFI for equity funds and hedge funds, bond funds and hedge funds are statistically significant (the correlation is negative and high). These data indicate that there is no significant homogeneity of investment funds regarding to their fragility on based the selected criteria and this is a positive signal of a relatively low probability of a simultaneous significant high-correlated negative reaction to negative shocks.

The results of the analysis indicate the statistical insignificance of the correlation of investment funds financial fragility indices (except for mixed funds) and Composite Indicator of Systemic Stress in the Euro area (CISS, equal weights). Regression analysis of changes in the mixed invest-

ment funds financial fragility index and CISS (tab. 6) showed that the mixed investment funds financial fragility reduced in stressful periods in the Euro area financial system, i.e. investments in the financial instruments of these funds, with other unchanged conditions, to some extent can be considered as anti-stress investments.

Table 5. Correlation matrix of the investment funds financial fragility indices (2008Q4 – 2018Q4)

	Equity funds	Bond funds	Mixed funds	Hedge funds	EURO STOXX 50	CISS
Equity funds		0,3142	0,2356	0,1424	-0,4400	0,0455
<i>p-value</i>		0,0483	0,1433	0,3806	0,0045	0,7803
Bond funds	0,3142		0,3096	0,2658	-0,0354	-0,0578
<i>p-value</i>	0,0483		0,0519	0,0974	0,8281	0,7233
Mixed funds	0,2356	0,3096		0,0064	0,2370	-0,3277
<i>p-value</i>	0,1433	0,0519		0,9687	0,1410	0,0390
Hedge funds	0,1424	0,2658	0,0064		0,1727	-0,1952
<i>p-value</i>	0,0483		0,0519	0,0974	0,8281	0,7233
EURO STOXX 50	-0,4400	-0,0354	0,2370	0,1727		-0,3433
<i>p-value</i>	0,0045	0,8281	0,1410	0,2866		0,0301
CISS	0,0455	-0,0578	-0,3277	-0,1952	-0,3433	
<i>p-value</i>	0,7803	0,7233	0,0390	0,2274	0,0301	

Source: prepared by Author.

The regression analysis showed the significance of the reverse impact of changes in the return of the stock index EURO STOXX 50 on the change in the equity funds financial fragility indices (tab.6).

Table 6. The results of the regression analysis of the relationship investment funds financial fragility indices in the Euro area with CISS and the stock index EURO STOXX 50 (2008Q4 – 2018Q4)

Dependent variable	Independent variables	Coefficient of independent variable	t-statistic	Durbin-Watson (DW) statistic	R-squared, %
Change in the equity funds financial fragility index	Return of the stock index EURO STOXX 50	-1,2011	-3,02 (0,0045)	2,73 (0,9916)	19,36
Change in the mixed funds financial fragility index	Change in CISS	-0,23	-2,14 (0,0390)	2,39 (0,8907)	10,74

Source: Prepared by Author. P-value in parentheses

During the analyzed period (2008Q4 – 2018Q4) the highest equity funds financial fragility (Fig. 5) was observed in 2009, when there were the highest levels of interconnectedness with other financial institutions and liquidity mismatch. The index values decreased further and they are at an acceptable average level. For hedge funds, the highest values were also observed in 2009. The highest value of the bond funds fragility was noted in 2014, when the high values of leverage multiplier and interconnectedness with other financial institutions were recorded. For mixed funds, the peak was at the end of 2012, when there were high values of liquidity mismatch and intercon-

nectedness with other financial institutions. At the end of the studied period, FFI for all funds had moderate values.

Figure 5. Dynamics of the investment funds financial fragility index in the Euro area



Source: Prepared by Author

Most funds are characterized by a slight fluctuation of financial fragility indices, which did not exceed 22.5% (coefficient of variation – table. 7). Very high financial fragility (about 0.9) was observed only for equity funds.

Table 7. Descriptive statistics of investment funds financial fragility indices

	Equity funds	Bond funds	Mixed funds	Hedge funds
Standard deviation	0,115231	0,0939731	0,0989222	0,086687
Coeff. of variation	22,4975%	18,501%	19,328%	16,9502%
Minimum	0,293651	0,325397	0,269841	0,333333
Maximum	0,896825	0,68254	0,65873	0,68254

Source: Prepared by Author

CONCLUSION

The analysis of the factors of investment funds financial fragility on the Euro area example, including the developed financial fragility index, showed that at the present stage, these investment institutions are characterized by a generally acceptable level of sensitivity to market fluctuations. A positive signal in terms of the stable functioning of the financial system is mainly statistical insignificance of the financial fragility indices correlation of different types of investment funds, as well as with the Composite Indicator of Systemic Stress in the Euro area. Regression analysis showed reverse behavior of the equity funds financial fragility index in relation to the situation on the stock market. However, these data are somewhat limited due to the lack of sufficient statistical data in the ECB database. Especially, when calculating leverage, the investment funds positions on derivatives, which will significantly increase the level of fragility of funds, were not taken into account. The results also indicated that the level of homogeneity of investment fund strategies (namely hedge funds) and their procyclical behavior in relation to trends in the stock market increases during crisis periods. Besides, more than half of the investment funds assets are investments in financial instruments markets outside the Euro area, which is caused by the actualization of regulatory arbitrage in connection with the increase in regulatory requirements in the EU, and it increases the possibility of investment funds contagion in the Euro area during the international markets` destabilization.

Particular important are the results obtained due to the significant increase of the investment funds assets in recent years. At the end of 2018 the total assets of investment funds in the Euro area increased by about 2.7 times compared to the end of 2008. It requires increased attention on the part of portfolio managers to account the investment funds financial fragility for ensuring optimal management and avoid destabilization in this sector of the financial system, given its growing importance. Further research in this area should be focused in the direction of expanding the base of calculation of financial fragility indices on the basis of accounting data on balance sheet and off-balance sheet derivatives, calculating the indicator of synthetic leverage, and it is advisable to develop the models of investment strategies for portfolio managers, which would take into account the influence of directions and structure of investments on the investment funds financial fragility indices.

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