How homogeneous diversification in balanced investment funds affects portfolio and systemic risk[1]

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Abstract

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Keywords: Portfolio diversification, Risk, Asset allocation heterogeneity, Market crash.
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Abstract

The last financial crisis sheds dramatically light on the instability threatened by systemic risk. In this regard no common view appears to exist on the definition, the measurement and real impact on financial system. This paper aims to analyze the relation between systemic risk and portfolio diversification, highlighting the differences between heterogeneous and homogeneous diversification. Diversification is generally accepted to be the main tool for reducing idiosyncratic or portfolio-specific financial risk, but the homogeneous diversification produces also effects on systemic risk. The research consists of three steps to investigate how diversification affects the two components of portfolio risk: (i) systematic, and (ii) idiosyncratic risk. Through the impact on the level of portfolios allocation homogeneity, we assess how (iii) the diversification affects systemic risk. The empirical research implements the estimation strategy through balanced investment funds data, examining the change in asset allocation and the impact on the measures of different types of risk. The results suggest that funds' portfolio diversification reduces at the same time the portfolio-specific risk increasing the likelihood of a simultaneous collapse of financial institutions-given that a systemic event occurs.

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1. Introduction

"Every happy family is the same. Every unhappy family is miserable in its own way"
(Leo Nikolayevich Tolstoy, 1877)

Citation, Laurence H. Summers (May, 2000).

The experience of the last financial crisis sheds light on the dangers coming up from systemic risk. This led academic research as well as financial institutions to face this threat for financial market functioning. The debate on the definition of systemic risk as well as on the sources of the last turmoil is still open. If Schwarz (2008) <28>, discussing systemic risk, states that "if a problem cannot be defined it cannot be solved", Tirole (2002) <33> argues that "two crises are never identical and each one shows own distinctive elements".

Given that the last distress may be considered aas an example of systemic crisis, our research investigates a potential root of systemic risk: the degree of homogeneity market agents as consequence of their portfolio diversification strategy. The common threat of systemic risk definitions, in fact, is the experiencing of a collapse of the entire financial system.[1] Hence, if the market's agents are mutually similar or homogeneous the likelihood that a systemic event affects all of them in the same way increases. Thus, portfolio diversification, usually considered as one of most important tools to mitigate risk and implemented by financial investors to reduce own portfolio risk, may increase the likelihood of a systemic crisis.[2]

The aim of this paper is to examine these two sides of the diversification process by analyzing the impact of diversification on different types of financial risk. More precisely, we investigate over the past ten years how diversification has impacted portfolio and systemic risk. The former may be decomposed in two components: i) systematic risk, which stems from the sensitivity of portfolio returns to market returns, and it is usually measured through the portfolio β factor -the correlation between the portfolio and market returns; ii) idiosyncratic risk, which depends on the specific portfolio factors and it is the portion of portfolio risk not explained by market factors. In the financial literature systematic risk is considered non-diversifiable while the second component of portfolio risk may be reduced through an adequate portfolio diversification strategy which neutralizes the risk-components related to portfolio-specific factors.[3] Therefore, if the portfolio idiosyncratic component is reduced, the level of mutual homogeneity among market's agents increases, making them vulnerable to a simultaneous collapse when a negative systemic event occurs. Thus, starting from different conditions and expectations, market agents become homogeneous because of their portfolio diversification strategy, increasing the level of systemic risk of the financial system.

Our investigation proceeds along three consecutive steps: i)portfolio systematic risk or the *beta factor* is estimated and analyzed; ii) the relation between the idiosyncratic portfolio risk and the portfolio diversification is investigated; iii) the impact of portfolio diversification and homogeneity level of the financial system on the likelihood of a simultaneous downturn is assessed.

[1] Engle and Brownlees (2010) <15>, De Bandt and Hartmann (2000) <10>, Lehar (2004) <25>, De Nicolo and Kwast (2002) <11>.

[2] It can be defined as a systemic event that affects a considerable number of financial institutions or markets, in a strong sense and severely impairing the general well-functioning of the financial system (De Bandt and Hartmann (2000) <10>).

[3] Goetzmann, Kamur, 2001 <19>; Fama, MacBeth (1973) <18>.

The remaining of the paper is organized as follows: Section 2 introduces and reviews the related literature; Section 3 describes the estimation model; Section 4 presents the dataset and the descriptive findings; Section 5 shows the results of the empirical estimations. Section 6 concludes.

2. Related literature

The debate about systemic risk is recent and the related literature is still limited. Moreover, there is not a common view on the definition of systemic risk. Let's briefly review some of these below.

Fifteen years ago, Alan Greenspan (1995) <20> said that "*the very definition of systemic risk is somewhat unsettled*". The statement appears an alert to financial research after the dramatic events such as the European Monetary System in 1993, and the Mexican crisis in 1994. Since that moment many strands of investigation about this threat to the economic system have been developed.

We may list four different approaches to the concept of systemic risk: (1) risk that an event affects a large number of financial institutions and markets at the same moment, (2) a domino-effect that occurs through common exposures of financial institution to a certain asset, (3) a banking default or a broader market participants' default as key factors, (4) a negative externality involving real effects.

In the first approach the systemic risk may be thought as the likelihood that a trigger event such as an economic or financial shock may cause significant adverse effects in a large portion of financial institutions or markets. This strand of literature (by Engle and Brownlees (2010) <15>, Kupiec and Nickerson (2004) <23> and Dow (2000) <13>), defines systemic risk as the risk of a simultaneous collapse of market agents acting in the financial system. In Dow (2000) <13> systemic risk produces its effects in four different ways: disruption of a payment system due to one or more banks' defaults, depression of banking asset values, general fear of losing savings (simultaneous withdrawals from banks) and reduction of national income linked to macroeconomic changes. Kupiec and Nickerson (2004) <23> describe other potential ways of systemic risk impacting on the financial system: price volatility, corporate liquidity, efficiency losses.

In the second group we can include an opposite view by Kaufman (1996) <22>, De Bandt and Hartmann (2000) <10>, Sheldon and Maurer (2008) <29>, Schwarcz (2008) <28>. These authors explain that systemic risk acts as a domino-effect due to linkages between the financial institutions. Kaufman (1996) <22> refers to the cumulative losses caused by an event that ignites successive losses along a chain of financial institutions or markets. De Bandt and Hartmann (2000) <10> relate systemic risk to the experiencing of a systemic event. This involves a Y institution in second-round as a consequence of an initial shock that has impacted on the X institution even if the Y one was fully solvent at the beginning. This view is also in Bartram *et al.* (2005) <4>, where systemic risk affects the unexposed institutions not otherwise affected by a crisis, given their economic fundamentals. The domino-effect is explicitly defined as the likelihood that a failure of one bank triggers a chain reaction causing other banks distress through interbank loans (Sheldon and Maurer, 2008)(2008) <29> and as a trigger event that causes a chain of bad economic consequences (Schwarcz, 2008 <28>).

In the third approach the banking default is the key element to define systemic risk. Eisenberg and Noe (2001) <14> refer to the number of waves of default needed to cause a firm's default in a closed financial system. Lehar (2004) <25> assesses systemic risk as the probability that a certain number of banks within a time period fall in default due to the fall of the value of banks' assets below a value of banks' liabilities. This view stems from Merton's (1974) <26> structural models where bank's default occurs when the value of its assets falls below a given threshold. Considering not only a bankruptcy condition but all market participants' default, the Bank for International Settlements (BIS, 1994) <3> defines systemic risk as the risk that a failure of market participants to meet their contractual obligations may cause other participants' default. Such definition is shared by the US Commodity Futures trading commission (2008) <9> which describes systemic risk as the risk that a market participant's default involves the other participants due to the interlocking nature of financial markets.

In the last approach, De Nicolo and Kwast (2002) <11>, Kambhu *et al.* (2007) <21> discuss systemic risk as a negative "externality", either through the direct linkages given by intermediaries' exposures and through a broader disruption directly affecting the financial markets. The impact of this market failure has an effect on the cost of capital, producing a reduction in credit provision as well as in real activity. The authors underline the fact that real effects of systemic risk constitute the main treat. However, they distinguish systemic from financial crises. In De Nicolo and Kwast (2002) <11> the financial failures have to be so high as to induce real consequences such as reductions in output and employment. In Kambhu *et al.* (2007) <21> the effect is a reduction of productive investment due to the decreasing credit provision. But in the authors' opinion the optimal level of systemic risk is not zero.

Few similar researches may be found in previous literature about the relation between diversification, portfolio and systemic risk.

De Vries (2005) <12> argues that diversification reduces the frequency of individual bank failure when a shock is smaller and easily borne by system, while it increases the likelihood of a systemic failure when a stronger shock occurs. Allen *et al.* (2010)<1> analyze the systemic risk focusing on the banking sector and the interconnections among the banks looking especially to signal perceived by investors who have to roll their investments in the same banks. The banks are involved in a network and each bank's condition is a signal for the entire banking system. The network is the result of the diversification process of the banks who desire to share their projects with other banks to grant a lower default probability and a lower repayment to creditors.

The same process makes up a "clustered" network in which each bank holds the same portfolio, so that each bank's signal is of interest for investors. Wagner (2006) <34> considers an economy with two banks which have to set the optimal level of diversification. Full diversification is undesirable because it reduces the risk at individual institution but increases the risk of a systemic crisis. The bank has incentives to fully diversify because it externalizes the costs, thus producing an increasing of the likelihood of failure for the other banks. The level of diversification has to be arbitrarily small, depending on difference between costs of individual failure and a systemic crisis.

Diversification may increase the likelihood of a contagion too, exposing banks to the consequences of the failure of other banks in which the first one diversified its investments. Allenspach and Monnin (2007) <2> test the hypothesis of the existence, between 1993 and 2006 of an empirical link between common exposure to shocks and systemic risk. If all banks choose to diversify, they are all exposed to the same risk factors.

Considering a broader notion of systemic risk that includes the contagion of financial turmoil across different countries or regions, Schinasi and Todd Smith (2000) <27> relate the diversification between risky and riskless assets, especially looking to the rebalancing of portfolios among these two different classes of securities, with the contagion effect from one region, where the shock occurs, transmitted to the other region. Focusing on Russian default of 1998, this paper shows that one shock leads the leveraged portfolio to a reduction of other risky positions (in other regions, markets, industries) according to all management rules, thus discovering the implicit and potential danger within the portfolio diversification.

3. The estimation model

The framework proposed below aims to analytically describe the relation between diversification, portfolio risk and systemic risk through a multistep analysis that begins from the portfolio return decomposition and explanation. The goal of is to show how diversification activity impacts on different terms of financial risks to capture the net effect of diversification on portfolio and systemic risk. Many papers (Fama, 1972 <16>; Becker, Hoffmann, 2008 <5>; Goetzmann, Kamur, 2001 <19>) focus on consequences of diversification on individual risk-taking without pointing out the impact on the entire system. Another strand of literature (Allenspach, Monnin 2007 <2>; Allen *et al.* 2010 <1>, Wagner, 2006 <34>) attempts to assess how banking diversification affects the risk that the whole banking system will collapse. By contrast, the model below aims (i) to evaluate the impact of diversification on different components of risk for a representative agent, and (ii) to assess the consequences for the entire financial system.

3.1. Portfolio return and β factor

Consider an economy with i agents, with i going from 1 to n. Each agent holds a portfolio composed by different asset classes (from here, we identify each agent with his own portfolio. In other words, i identifies at the same time the agent as well as the portfolio). Each portfolio consists of k asset classes (with k going from 1 to m), and each asset class weighs w_k into the agent's portfolio. Thus, the portfolio is a basket of k-asset classes and the relative portfolio size may be described as follows:

$$PS_{it} = \sum_{k=1}^{m} W_{itk}, w_{itk} = \frac{W_{itk}}{PS_{it}},$$

where PS_{it} is the size of portfolio i at time t (with t going from 0 to s), W_{itk} is the amount of portfolio i at time t allocated to asset class k, and w_{itk} is the weight of each k asset class in the portfolio i at time t. The sum of asset classes' weights w_{itk} is equal to 1.

For the aim of the paper it is useful to refer to the strand of literature related with the traditional financial theory of market models where portfolio return is explained by different components: i) a constant term, ii) the portion of portfolio return explained by the co-movements between the portfolio and the market returns (systematic factors of portfolio return), and iii) the portion of portfolio return not explained either by the constant term or the systematic factors identified as idiosyncratic or specific component:[4]

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}. \tag{1}$$

In (1) R_{it} is the return of portfolio i at time t, α_i is the constant term, and R_{mt} is the market return at time t. β_i is the factor that explains the sensitivity of i-th portfolio return respect to the market return, and ε_{it} is the portion of portfolio return neither explained by market return nor by the constant term. ε_{it} is the idiosyncratic component of portfolio return, the portion of portfolio return explained by portfolio specific factors.

[4] Among other see: Black *et al.* (1972) <6>

3.2. The impact of diversification on portfolio risk

It is now interesting to investigate the relation between the model described in equation (1) and the portfolio diversification process. In order to do this, we need to construct a diversification measure of agents' portfolio. For this purpose, we use Herfindahl's measure of concentration and compute its complement as proposed by Woerheide, Persson (1993) <35>, Lang, Stulz (1994) <24>, Byrne, Lee (2001) <7>, Goetzmann, Kamur (2001) <19>:

$$HI_{it} = \sum_{k=1}^{m} w_{itk}^2,$$

where HI_{it} is the Herfindahl concentration measure of portfolio i at time t, that is the sum of the squared weights of k asset classes (w_{itk}). Our diversification index DIV_{it} is the complement to 1 of H_{it}:

$$DIV_{it} = 1 - H_{it}. \tag{2}$$

We can evaluate how the portfolio diversification of the own portfolio of agent i and the other $j \neq i$ agents' portfolios impacts on the portfolio risk of i-th agent, focusing on the idiosyncratic component. For this purpose we build a measure of idiosyncratic portfolio risk, based on the standard deviation of the residuals (hereby, RSD) in (1) defined as $\sigma_{it}(\varepsilon_{it})$.[5]

We use this approach to estimate portfolio diversification to investigate how the diversification process of the own portfolio of agent i and the other $j{\neq}i$ agents' portfolios affects the idiosyncratic term of i-th agent's portfolio risk.[6]

The analysis may be implemented using the idiosyncratic risk of portfolio i as dependent variable, where the independent variables are the diversification index of the i-th portfolio, the average measure of other portfolios diversification, and a set of variables that describe the asset allocation choices of agent i:

$$\sigma_{it}(\varepsilon_{it}) = \alpha_0 + \alpha_1 DIV_{it} + \alpha_2 \overline{DIV_t} + \sum_y \alpha_y V_{iyt} + \upsilon_{it}, \tag{3}$$

where α_0 is the constant term, DIV_{it} is the diversification degree of portfolio i at time t, $\overline{DIV_t}$ is the average degree of diversification of the n agents' portfolios at time t, and V_{iyt} represent the asset allocation variables (with y, going from 1 to q, is the number of the variables), and υ_{it} is the error term.

3.3. The relation between diversification, asset allocation of economic agents, and systemic risk

The third and final stage of the estimation model focuses on systemic risk and the relation between systemic risk and diversification. More precisely, the aim of this investigation is to assess how diversification impacts on the degree of heterogeneity of asset allocation among market agents. In fact, if systemic risk is defined as the risk that a given event produces a simultaneous collapse of all market agents and entire system, then this condition occurs with a larger probability when the agents are similar and vulnerable

[5] Fama, MacBeth (1973) <18>.

[6] The latter diversification term may be computed as follows: $\overline{DIV_t} = \frac{1}{n}\sum_{i=1}^{n} DIV_{it}$. This indicator measures the average degree of diversification of the financial system at each time t.

to similar threats.[7] In this case the given event affects all agents in the same way. To measure the level of agents' heterogeneity we construct a dispersion index of portfolio asset allocation:

$$DISP_{it} = \frac{1}{m}\sum_{k=1}^{m}(w_{itk} - \overline{w_{tk}})^2, \tag{4}$$

where $DISP_{it}$ is the dispersion index of portfolio i at time t, w_{itk} is the weight of k-th asset class at time t in portfolio i, $\overline{w_{tk}}$ is the average weight of k-th asset class at time t across all n agents' portfolios.

$DISP_{it}$ measures to the extent the weights of k asset classes in portfolio i are different from the average weights of the k asset classes in all n agents' portfolios for each time t. From this index $DISP_{it}$ it is possible to define an average value for each time t among all portfolios to measure the level of heterogeneity in terms of asset allocation of the financial system:

$$HET_t = \frac{1}{n}\sum_{i=1}^{n} DISP_{it}, \tag{5}$$

where HET_t is the weighted average heterogeneity index of the financial system at time t.

Considering the definition of systemic risk, it is worth to investigate when and in what condition a simultaneous collapse occurs and what is the relation among portfolio diversification, heterogeneity and a market agents' simultaneous downturn indicator. As stated by Engle, Brownlees (2010) <15>, Acharya *et al.* (2009, 2010) <18>, a systemic event may be defined a market loss that overcomes a given threshold (TS) and systemic risk is the expected shortfall suffered by market agents when the systemic event occurs. Hence, Engle, Brownlees (2010) <15> build an expected return estimation model that takes into account different factors in addition to market return. In particular, they measure the expected loss suffered by a portfolio when the market loss overcomes TS. The sum of these expected shortfalls is considered as a proxy of systemic risk. Following this approach, it is possible to compute the simultaneous downturn (hereby, SD) rate as the ratio of portfolios that record a certain shortfall when the market loss overcomes a given threshold:

$$SD_{rate} = \frac{N^o portfolios(R_{iz} < TS)}{N^o Portfolios}, \tag{6}$$

where z is a specific period in t where the condition $R_{mt} < TS$ occurs. Therefore, following Engle and Brownlees' approach (2010) <15> and relating with the traditional market model estimation described in previous section, we may build a return estimation model which takes into account market return, portfolio diversification and heterogeneity, to evaluate how diversification and heterogeneity affect this simultaneous downturn rate. From the simple market model in equation (1) we move to the following return estimation model:

$$R_{it} = \alpha_i + \beta_{1i}R_{mt} + \beta_{2i}HET_t + \beta_{3i}DIV_{it} + \eta_{it}, \tag{7}$$

[7] According to the first strand of literature proposed in Section 2.

where η_{it} is the error term. In this way, given a market return, it is possible to assess the impact of diversification and heterogeneity: i) on the return of portfolios and on the average return of the whole financial system; ii) as consequence, indirectly, on the simultaneous downturn rate. The latter allows to evaluate how diversification and heterogeneity impact the number of portfolios that drop at the same time. Once the coefficients have been estimated, the arbitrary fixed level of market return (market crash) is applied to calculate (i) the average of portfolio returns, and (ii) the SD rate. Finally, to isolate the effect of diversification, the heterogeneity index (HET_t) is fixed so that the trend of average return and SD rate depends only on the diversification index (DIV_{it}). The same procedure is implemented to isolate the effect of heterogeneity fixing the portfolio diversification index.

4. Descriptive findings

4.1. Data

The dataset consists of 233 balanced investments funds out of a universe of 1500 largest balanced investment funds from November 2001 to December 2010.[8] In the dataset we have monthly variables that may be grouped in two categories: i) the main characterizing treats of funds; ii) variables that capture the composition and the allocation strategy of funds.

The first group of variables includes i) *return*, the performance of fund *i* in a particular month *t*; ii) *fund size* is a measure of month-end net assets of fund *i* in a given month *t*, recorded in millions of euro.

The second category of variables is related with the asset allocation strategy of funds. The main variables are: *asset allocation bonds, asset allocation equity, asset allocation cash, asset allocation other* (AAb, AAe, AAc, and AAo respectively). They measure the monthly amount percentages of fund investments allocated to each one of these assets class for different sub-asset allocations. On the equity portion of asset allocation, the first sub-category of asset class deals with the geographic allocation: North America (Ena), United Kingdom (Euk), Eurozone (Eeuro), Emerging markets (Eem), Asian developed countries (Easia), Japan (Ejapan). The other sub-category for asset allocation equity concerns super-sectors, that include many similar and homogeneous industries. The equity super-sectors are: *manufacturing, information and services* (Eman, Einf, and Eserv respectively). Bonds constitute the second asset category for which sub-asset allocation observations are available. It is possible to separate bonds allocation into five super-sectors: *United States government, United States corporate, Non-US government, Mortgage and Cash* (Busgov, Buscorp, Bnonus, Bmortg, and Bcash respectively). These represent the portion of asset allocation bond invested in bonds of United States government; United States private company bonds; bonds issued by public authority with the exception of United States; bonds related with the different kinds of mortgage that have been securitized and transformed in market bonds; bonds with maturity less than twelve months respectively. The last sub-asset allocation refers to the credit quality rating. For each month, the percentage of total asset allocated to bonds rated *aaa, aa, a, bbb, bb, b, below b* are available.

[8] Data are provided by Morningstar Italia. The selected funds are those funds that have over 70% of non-missing observations on the asset allocation variables from 2001 to 2010. We decide to start our analysis from the first month after the economic recession of 2001 (November 2001), according to the St. Louis Federal Reserve<30> estimation.

4.2. Summary statistics

[Insert Table 1, here]

Looking at the fund performance measure, *returns* suggest some considerations. For the whole sample, returns present a .5% mean (table 1, column (3)) with the skewness of -.86 (column (5)). The presence of fat tails is confirmed by a value of kurtosis equal to 6.84 (column 6). Extreme values in monthly returns are described by -19.02% and 20.71% respectively (columns (1), and (2)).

Looking to asset allocation, it is quite clear that funds prefer to invest mostly in equity markets (see AAe, column (3)). This tendency is stronger for North American funds where over half of the funds' investments are allocated to equity markets. The preferred equity market for all funds is surely the North American (see Ena, column (3)). Asian and emerging equity markets represent a very small portion of investments (see Easia and Eem, column (3)).

Furthermore, asset allocation cash and other show very high minimum negative value (see AAc and AAo, column (1)). This feature may be a signal of aggressive short strategies acted by funds. However funds seem to be really risk-averse about their Bonds allocation. They allocate the largest portion of bond investments to low risk assets (see table 1, column (3), variables Ba, Baa, and Baaa). The average percentage of bonds aaa is 45% for the whole sample. By contrast, the portion allocated to the riskiest bonds (below B) is below 1%. In the second sub-asset bond allocation (super-sectors), all funds tend to allocate their portion of bonds to non-United States government and short-maturity bonds (see column (3), variables Bnonus and Bcash). There are no strong differences between North American and European funds, except for a particular bond sector, the mortgages (Bmortg). The North American funds allocate to this market one bond out of 10, the European funds only allocate one out of 200.[9] Counter intuitively, the European funds on average are larger than the North American.

It is useful to focus on the differences among two different time periods: the pre-crisis of 2007 (January 2005-June 2007), and from the last financial crisis on (July 2007/December 2010).

[Insert Table 2, here]

It is possible to observe from Table 2 how the distribution of the returns changes between the first and the second period of our analysis. The average return is .65% (Table 2, column (3)) in the first period, whereas it decreases to .2% (column (10)). The fat tails phenomenon is more pronounced in the pre-crisis: 6.59% versus 5.89% (columns (6) and (13) respectively). Furthermore, signals of a large volatility over the years of the last financial crisis are supported by a larger standard deviation (3.21%, column (4)) with respect to the previous period (2.38%, column (11)).

Looking at the four principal asset allocation variables, no strong differences are evidenced by the summary statistics. Asset allocation equity, bond and cash show a slide increase from the first to the second period, while the asset allocation *other* strongly falls over the last crisis (see column (3) and (10), variables AAe, AAb, AAc, AAo respectively). It seems obvious to think of the well-known "fly to safety" of investors when the crisis bursts.

[9] We define the country of origin for each fund according to the inception domicile provided by Morningstar.

5. Estimations results

In this section we implement the estimation model with the sample previously described. The empirical analysis that follows the agent i described before will be proxied by the fund i, while the time t will be with a monthly frequency.[10]

As stated in the introduction our analysis consists of three steps aim to capture different sides of the financial risk related with the diversified investments. The first two steps evaluate the portfolio risk, decomposed in their two fundamental components. However, the main contribution of the paper is the third step where a return estimation model stresses the impact of agents' diversification strategy and agents' portfolios heterogeneity on the risk of a simultaneous collapse of the investors (section 5.3). This effect is also tested augmenting the classical market model with these two additional explanatory factors (diversification and heterogeneity). To check the robustness of our model we also consider a multi-factor model (Fama and French, 1993 <17>; Carhart, 1997 <8>).

5.1. Portfolio return and β factor

The first step of our analysis deals with the investigation of the relationship between funds' returns and market proxy returns, to estimate the β factor. We estimate the β factor in equation (1) for both sample period and pre-sample five years period.[11] For the sample period, we perform a random effects panel regression as in equation (1) using the following specification:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \sum_d \alpha_d C_{idt} + \varepsilon_{it},$$

where C_{idt} is the set of control variables (with d, going from 1 to g, is the number of the controls), and ε_{it} is the error term. We check for years effect (*Year Dummies*), and region effect (*North America*). We also define dummies to control for the effect of the Crisis (taking 1 if t is between July 2007 and December 2008, zero otherwise), the Pre-Crisis (January 2006-June 2007) and the Post-Crisis periods (the time periods subsequent to the crises of 2001 and 2007-2009: November 2001/April 2003, January 2009/June 2010, respectively). Other control variables are constructed to take into account for fund size (*Log Fund size*), to control for inception date (*Inception date*; that is 1 if the fund has been incepted after the first month of the time window of analysis (November 2001), and zero otherwise), and to check for the nature of the fund (*Speculative*; takes 1 when the fund is a speculative and zero otherwise).[12]

[Insert Table 3, here]

As Table 3 shows, the sensitivity of funds returns (return) to market returns (Global market) is close to 1 in all the estimates -(1) to (10)- suggesting high integration between the market and all financial agents. In other words, the co-movements of the funds and market returns are very synchronized over time. The North America dummy is significant and positive highlighting the overall better performance of North American funds

[10] Recalling section 3.1 we identify the agent i with his own portfolio i.

[11] We use the same approach of Black *et al.* <6> in estimating the pre-sample β. We estimate the β factor for the pre-sample period (November 1996 - October 2001) to compare with the β estimation in the sample period. We do not report the pre-sample beta estimation results because we do not rank funds by β factor.

[12] In our dataset we define *speculative* a fund when the overall mean of speculative bonds (sum of bonds below the triple B) owned by fund over the time window of analysis overcomes the overall mean of the entire sample.

along the past decade. The *crises* dummies show the expected sign: negative impact on funds' return for the Post-Crises and the Crisis (estimates (3) and (5)); positive impact for the Pre-Crisis. All the results remain the same when we add the fund's characteristics (estimates (6) to (10)).

The results described above stem from a panel regression of equation (1) that returns one beta factor for all funds. However, it may be interesting estimate different beta for each time series using the following model:

$$R_t = \alpha + \beta R_{mt} + \varepsilon_t, \tag{8}$$

where equation (8) is estimated for each fund i. This estimation model implies, contrary to the hypothesis of panel, that the time series are considered as mutually independent. The results show that the largest portion of all funds has a beta factor close to the the market line (β=1). Only few funds show extreme values, less than .5 or more than 1.5. More precisely, 47 funds (20% of the sample) show these values whereas eight funds on ten have a beta factor between .5 and 1.5. 88 funds (more than 33% of the entire sample) show a beta factor value between .8 and 1.2. 89 funds can be defined *aggressive* with a beta factor of more than one. The largest portion of funds consists of *defensive* with a beta factor less than one.[13]

5.2. The impact of portfolio diversification, portfolio asset allocation, and diversification of the other agents on portfolio risk

In this section, we evaluate the relation between the funds' portfolio diversification strategy and the measures of idiosyncratic risk. We consider two proxies of idiosyncratic risk: i) the standard deviation of the panel β factor combined residuals, and ii) the standard deviation of the β factor time series estimation residuals.[14] We perform the estimation of equation (3) using the following specification:

$$\sigma_{it}(\varepsilon_{it}) = \alpha_0 + \alpha_1 DIV_{it} + \alpha_2 \overline{DIV_t} + \textstyle\sum_y \alpha_y V_{iyt} + \sum_d \alpha_d C_{idt} + \upsilon_{it},$$

where C_{idt} is the set of control variables (with d, going from 1 to g, is the number of the controls), and υ_{it} is the error term.

[Insert Table 4, here]

In the first set of regressions (Table 4, columns (1a) and (1b)) the proxy for idiosyncratic risk (RSD) -for both panel and time series model- is regressed against the funds diversification index DIV_{it}.[15] The DIV_{it} coefficients (Diversification in table 4) are both negative and statistically significant suggesting that diversification negatively affects the idiosyncratic risk. In column (2a) and (2b), the estimation takes into account the average diversification $\overline{DIV}_t$ (Av. diversification in Table 4) of the entire financial system. The findings may seem counterintuitive because of the positive sign of the coefficient (2.04 and

[13] Details on this time series estimation are available from the authors upon request.

[14] In computing the idiosyncratic risk as the standard deviation of residuals of equations (1) and (8) with the moving average approach we know that the wider the time window the more significant is the estimation and the higher the influence of older observations. The narrower the time window, the higher the weight of recent observations, the lower the significance of the estimates. To achieve an adequate compromise, we will use a time window of 36 six months, that is the same time window chosen by Morningstar in computing the standard deviation of portfolio returns.

[15] Performing the Dorby-Whatson-Hausman test and the Breusch-Pagan/Lagrangian multiplier test, the result suggest to run a fixed effects panel estimation model. However, we double check also with a random effects panel estimation model that confirms the results in the table 4.

2.00, columns (2a) and (2b) respectively). Despite that, the positive sign means that the higher diversification of all funds the higher appears to be the idiosyncratic risk of the single fund. If we consider the two measures at the same time, the fund diversification and the average diversification of all funds, the results described above do not change (columns (3a) and (3b)).

Table 4 column (4a) and (4b) include equity asset allocation among six different geographic regions: Asia (Easia), Emerging markets (Eem), Eurozone (Eeuro), Japan (Ejapan), United Kingdom (Euk), and North America (Ena). Emerging markets, UK and North America present a positive coefficient while Asia, Japan and Eurozone show a negative value. This difference may be referred to the different degree to which these regions were involved in the past crisis. North America and United Kingdom were both affected by the last crises, especially their financial systems. In the United Kingdom a dramatic instance of bank-run risk occurred during the collapse of Northern bank while both the bubble burst of 2001 and sub-prime mortgages crisis of 2007 began in United States before spreading to other regions of the world. The negative value of the Emerging Markets coefficient may be instead referred to the high volatility and fragility of these markets such that an investment in these economies may be rightly assessed as strongly speculative and risky. By contrast, investments in developed Asian and Japanese markets, also physically far from the last crises centers, appear to reduce portfolio riskiness. In the same way, investments in Eurozone markets reduce idiosyncratic risk. This is probably due to the different structure of European financial system, where financial markets are less volatile and the institutional architecture appears to be more consolidated.

The other outward counterintuitive finding is the significant negative value of mortgage bond coefficients (Table 4, columns (4a) and (4b)). The explanation may be provided by two factors: the good performance of real estate market during the years before the burst of the crisis and the credit quality of these assets. There is no information in fact about the specific category of these ones which may be low risk. In the same way, the cash bonds (with a maturity lower than one year) enter has a negative parameter. It can be expected because a short-term investment is more liquid and generally less risky.

The rest of the estimations (from column (5a) to column (8a), and from column (5b) to column (8b) respectively) show a negative impact on idiosyncratic risk before the burst of the last crisis, and over the months of the crisis. The portfolio idiosyncratic risk is positively affected from the last crisis on.

5.3. The relation between homogeneous diversification of economic agents and systemic risk

If we share that systemic risk is the risk that the entire financial system experiences a simultaneous distress when a given event occurs, the term *simultaneous* plays a prominent role in this concept. Two conditions seem to be fundamental to allow an event to affect at the same time the whole financial system: i) the event itself must be able to affect the entire system (*systemic event*) and ii) the level of similarity (or *homogeneity*) among agents and institutions must be sufficiently high. As stated in the estimation model - see equation (4) and (5) - we calculate the heterogeneity index HET_t from November 2001 to December 2010.

[Insert Figure 1, here]

Figure 1 shows an overall view of the simultaneous effect of diversification on idiosyncratic risk, the heterogeneity level of the financial system and the simultaneous downturn rate.[16] When diversification increases (until the beginning of the 2007 recession) the id-

[16] We need to choose the threshold (TS) of the equation (6) that, if overcome, evidences the experiencing of a systemic event. Following the Engle's approach (2010 <31>, 2011 <15>) the threshold (TS) may

iosyncratic risk decreases, the heterogeneity degree of financial system moves down, and the simultaneous downturn rate grows.[17]. Given that a systemic event occurs, diversification reduces the portfolio-specific risk while increases the likelihood of a simultaneous collapse of financial institutions. By figure 1 it also appears that the relation between these two factors and portfolio return is characterized by a lagged effect. This hypothesis may be tested through a return estimation model where these two variables (considering different lags for diversification and heterogeneity at one, six, and twelve months) are taken into account as proposed in equation (7).

Consequently, we run panel regressions model where the dependent variable is always the monthly fund returns. Different combinations of contemporaneous and lagged variables of the heterogeneity index HET_t and the diversification index DIV_t are proposed in the estimated model.

Among all these regressions, only three models show significant values for both diversification and heterogeneity variables. Three of them refer to short-run effect of lagged and contemporaneous heterogeneity (at time *t-6*, *t-1*, and *t*) and contemporaneous diversification on funds' returns; the other refers to the long-run effect of lagged heterogeneity (at *t-12*) and contemporaneous diversification.

[Insert Table 5, here]

The short-run results are shown in Table 5. Heterogeneity has a negative impact on funds' returns for all the lagged time and the contemporaneous one. Thus, the degree of similarity among portfolios' asset allocation produces a positive effect on funds' returns in the short period. This condition is perceived has a mitigator factor for systemic risk. A different way to interpret this result is that agents feel that homogeneity generates a positive perception of their asset allocation choices.[18] Contemporaneous diversification has a negative impact on monthly funds' returns meaning that the portfolio return decreases when the portfolio diversification increases.

[Insert table 6, here]

The long run-effect (Table 6) is characterized by the persistence in the sign for diversification but it shows a switch to positive sign for heterogeneity. We can interpret this shift in the sign of the latter as change in perception of the homogeneity degree in the asset allocation choices. In the long-run the similarity among funds' asset allocation choice is perceived by the market as a potential risk, while in the short-run was a mitigator factor. In other words, the increasing of the homogeneity level in the financial system produces negative effects on the funds' return only after a certain time lag.

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be fixed at -2%. In addition to Engle's approach (2010 <31>, 2011 <15>), using the same threshold (2%), we assess the SD rate as the ratio of the number of funds that show this loss (higher than 2%) -in the months that market loss overcomes this threshold. The indicator shows its highest values during the 2007 financial crisis period, and its peak corresponds to the month of Lehman Brothers' failure. The SD_{rate} index may thus be considered a good proxy to define a systemic crisis and to measure the risk of a simultaneous collapse of financial system given the market proxy building strategy. The market returns proxy used in this analysis is in fact constructed as weighted average of North American and European market proxies. Moreover, the market proxy is constructed reflecting the funds asset allocation, which is balanced among different asset classes (i.e. *equity, cash, bond, other*). Hence, the market proxy is a balanced index where at least one component (cash) is substantially less volatile than the others. Consequently, a strong drop of this index may be considered as a good signal of a systemic distress.

[17] This effect can be described with the expression "*the two faces of the same coin*"

[18] We decide to report only results for heterogeneity at *t-6* in Table 6. All other lagged measures show the same impact on fund's return.

Looking at both short and long run effect on diversification and heterogeneity we can conclude that agents in the market perceive asset allocation choices differently according to the lag in time. In the short-run the market seems to appreciate the homogeneity in agents' allocation choice to reduce both portfolio and systemic risk. This homogeneity is perceived by the market as a condition that makes agents more prone to suffer the consequences of a systemic event in the long-run.

Finally for the long-run results described above, it is possible to estimate for each fund the coefficients associated with the parameters described in the equation (7) through an OLS time series estimation where the dependent variable is the single fund return. The independent variables are: the market proxy returns, the lagged heterogeneity level, the fund diversification index. Once the coefficients have been estimated, it is possible to measure the prediction ability of the estimates through a panel t-statistic test. Over the whole time window the model predicts returns values not statistically different from effective values.[19]

We implement the model previously described by equation (7) to investigate the impact of heterogeneity and diversification on the average return of the financial system and the likelihood of a simultaneous collapse, given the occurrence of a systemic event. To this end, we fix the market return in the equation (7) and compute the PAR (Predicted Average Return) and SD (Simultaneous Downturn) rate, when a *market crash* occurs. To choose the fix level of market return, for simulating a systemic event (*market crash*), we implement the t-statistic test where the average return and the predicted average return become, respectively, the estimated average return when market loss is equal to 2% and the estimated average return when market loss is at a worst level. Thus, we run the test for different "worst loss levels", beginning from 2.1. We stop when all the time series values of the estimated average returns significantly differ from the estimated average return when market loss is equal to 2%. We identify this threshold as *market crash* equal to **-2.44%**.

5.3.1. The multi-factors model

The return estimation model described by equation (7) is here tested using the multi-factor approach presented by Fama-French (1993) <17>, and by Carhart (1997) <8>:

$$R_{it} = \alpha_i + \beta_{1i} R_{mt} + \beta_{2i} HET_t + \beta_{3i} DIV_{it} + \beta_{4i} SMB_t + \beta_{5i} HML_t + \beta_{6i} MOM_t + \eta_{it}, \quad (9)$$

where SMB_t (small minus big) is the difference between the returns on diversified portfolios of small and big stocks, HML_t (high minus low) is the difference between the returns on diversified portfolios of high and low book to market stocks.[20] The model by Carhart (1997) <8> extends the Fama-French model by incorporating an additional fourth factor that considers the momentum anomaly. The four factors model can be explained as a performance attribution model where the coefficients and premia on the factor-mimicking portfolios aim to explain the proportion of mean return attributable

[19] We perform the t-test on panel data as follows: $t = \frac{(\overline{R_{it}} - \overline{\hat{R}_{it}})\sqrt{\frac{N^2 g}{2N}}}{\sqrt{(N-1)\sigma^2_{R_{it}} + (N-1)\sigma^2_{\hat{R}_{it}}}}$ where $\overline{R_{it}}$ and $\overline{\hat{R}_{it}}$ are the cross-section average values of monthly effective return and monthly estimated return respectively, N is the number of cross-section observations, g is the number of degrees of freedom, σ^2 is the relative variance.

[20] The book-to-market ratio attempts to identify undervalued or overvalued securities by taking the book value and dividing it by market value. In basic terms, if the ratio is above 1 then the stock is undervalued; if it is less than 1, the stock is overvalued.

to four elementary strategies, where MOM_t represents the one-year momentum in stock returns. η_{it} is the error term.

The multi-factor model confirms (Table 7 and 8) the short and long-term impact of diversification and heterogeneity on funds' returns. As well as in the previous results, the short-run negative effect of heterogeneity appears at the same lagged (*t-6*, and *t-1*) and contemporaneous (t) time period. Model (9) also confirms the shift to positive impact heterogeneity effect in the long run (*t-12*). Finally, moving from the market model to the four-factor model, we still support the persistence in contemporaneous diversification negative effect on funds' returns for both short and long-run.

6. Concluding remarks

The last financial crisis highlights systemic risk as one possible variable that can play a role in policy makers decisions. The research investigates two aspects of agents' portfolio heterogeneity in terms of asset allocation: within the single portfolio, and across investors' portfolios. The latter may be considered one possible source of a systemic distress. The rationale behind this idea is that if agents' portfolios become more similar to each other, the likelihood of a simultaneous collapse increases.

The analysis has been implemented through a sample of investment funds over the last decade, in three steps. The first two steps concern about the impact of diversification on the two portfolio risk components, respectively: systematic and idiosyncratic. The last one focuses on the impact of portfolio diversification on systemic risk.

The findings appear to suggest that the diversification, even if is confirmed to be useful to reduce the portfolio specific risk, concurs to increase the degree of homogeneity among the investors. This condition worsens the risk that a negative systemic event produces a simultaneous collapse. If the agents allocated their wealth to the same assets a negative event affects all agents in the same way at the same time.

Our results are related with Wagner (2006) <34>, which argues that the fully diversification is undesirable because it reduces the risk at individual institution but increases the risk of a systemic crisis, and De Vries (2005) <12>, which argues that diversification reduces the frequency of individual institution failure when a shock is smaller and easily borne by system but increases the likelihood of a systemic failure when a stronger shock occurs.

Further strands of research may follow the investigation implemented in this paper. For example, it is possible to cluster the sample by regions (i.e. North America, Europe, Asia, Emerging Markets), ranking portfolios by funds' beta factor or improving the model forecasting ability for heterogeneity, diversification and systemic risk. These research proposals go beyond the aim of the paper, which may be also an alert against the recent provisions of the financial authorities. Common capital adequacy rules, indeed, while increasing transparency, also encourage homogeneity in investment strategy and undertaking of risk, leading to a high concentration of risk. That means that global regulations can be dangerous because they may increase the amplitude of global credit cycles (TaxPayers' Alliance, 2010 <32>).

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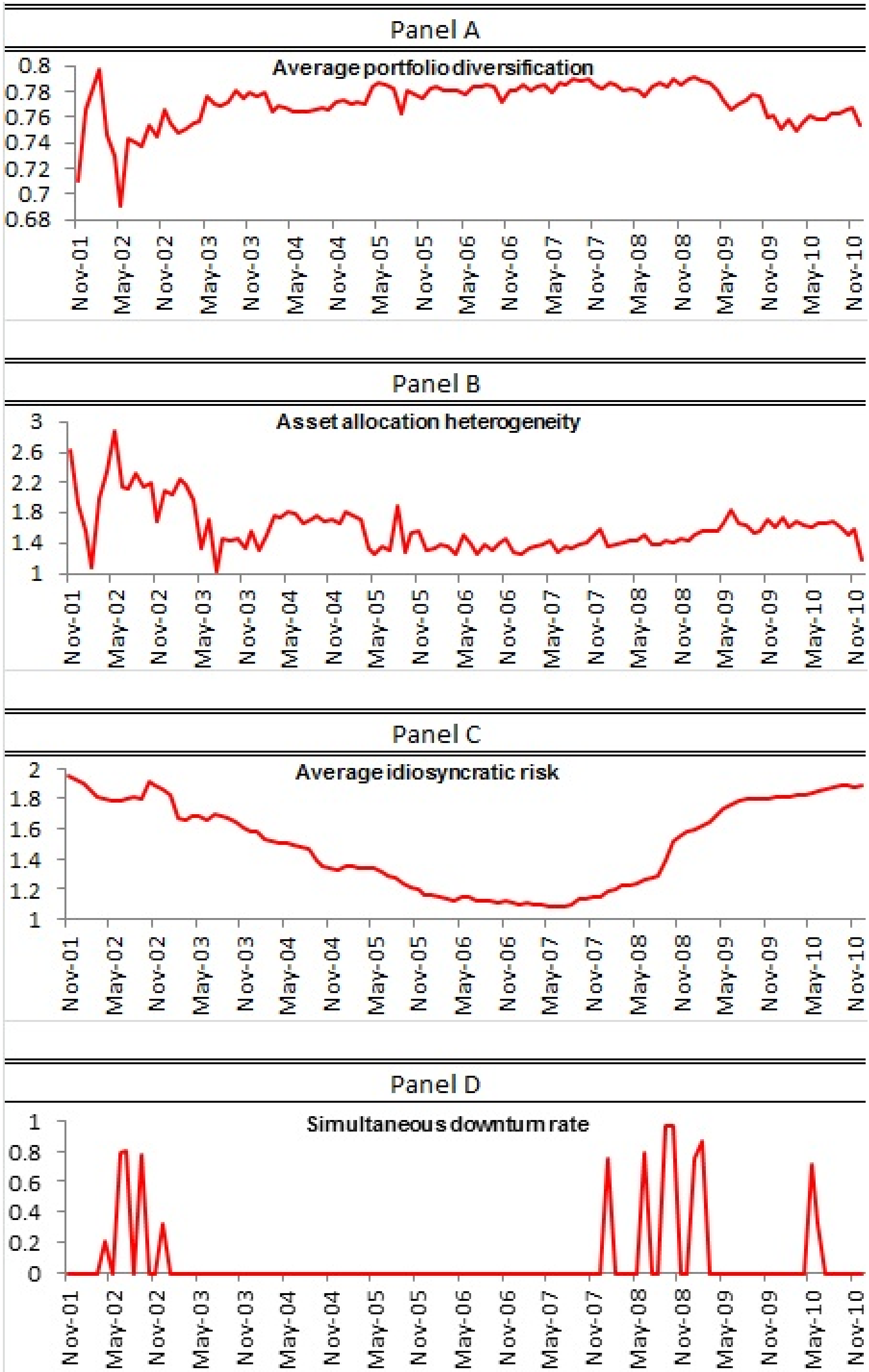
Figure 1: **Overall view**



The figure shows the overall view of the descriptive findings, over the time period November 2001-December 2010: .**Panel A** trend of the average diversification index ($\overline{DIV_t}$); **Panel B** trend of asset allocation heterogeneity indicator (HET_t); **Panel C** average idiosyncratic risk computed as mean of the idiosyncratic risk indicator $\sigma_{it}(\varepsilon_{it})$ among all funds i for each time t; **Panel D** simultaneous downturn rate as estimated in equation (6).

Source: Own elaboration on Morningstar data.

Table 1: **Summary statistics - overall sample**.

Var/Stat	(1) min	(2) max	(3) mean	(4) sd	(5) sk	(6) kurt	(7) p1	(8) p10	(9) p25	(10) md	(11) p75	(12) p90	(13) p95	(14) p99	(15) Obs
return	-19.02	20.72	0.5	2.69	-0.86	6.84	-8.17	-2.58	-0.77	0.7	2.04	3.42	4.45	6.51	33977
fs	0	37300*	1010*	1850*	6	54	0	30.5*	155*	485*	1030*	2320*	4040*	8660*	25676
AAe	-2.96	458.23	51.72	19.49	-0.1	11.31	0.99	23.5	39.42	56.19	63.79	73.97	78.94	89.25	23194
AAb	-32.15	598.85	33.7	18.92	2.79	52.79	0	11.39	22.62	32.46	42.09	58.04	65.66	80.14	23191
AAc	-543.79	493.8	9.09	12.34	-0.3	433.22	-2.19	1.65	3.68	6.87	11.63	19.06	27.28	47.46	23190
AAo	-488.76	100.1	5.53	15.11	-0.17	110.85	-2.95	0	0.13	0.79	4.67	14.79	29.74	79.12	23194
Easia	0	100	1.55	2.52	7.77	176.34	0	0	0	0.76	2.19	4.13	5.91	9.84	22980
Eem	0	61.42	1.7	2.98	4.21	37.45	0	0	0	0.56	2.21	4.71	7.5	13.35	22980
Eeuro	0	100	10.22	17.01	3.32	14.88	0	0	0.78	5.99	9.73	21.5	50.33	97.44	22980
Ejapan	0	69.09	3.21	5.03	5.27	49.1	0	0	0	2.14	4.69	6.93	10.3	23.94	22980
Euk	0	100	9.55	19.93	3.4	13.88	0	0	0.83	4.07	6.65	16.27	62.78	100	22980
Ena	0	100	50.42	32.9	-0.08	1.67	0	0.3	20.96	50.74	78.85	95.35	100	100	8178
Einf	0	72.67	15.62	6.72	0.97	6.59	0.12	8.06	11.59	15.17	18.97	23.22	27.17	37.1	22966
Eserv	0	100	45.58	8.81	0.62	8.45	21.28	36.62	40.99	45.28	49.79	55.18	59.98	69.26	22966
Eman	0	100	38.8	9.87	0.52	5.99	15.87	27.57	33.32	38.46	43.68	49.78	54.77	69.53	22966
Bnonus	0	100	49.11	34.04	-0.3	1.56	0	1.2	6.91	59.56	77.84	88.93	94.96	100	21428
Bcash	0	100	24.51	24	1.38	4.48	0	0	6.86	17.61	33.98	60.28	75.8	100	8005
Bmortg	0	99.97	7.85	13.95	1.77	5.01	0	0	0	0.24	8.18	32.2	40.57	51.38	21428
Buscorp	0	100	17.16	19.05	1.8	6.45	0	0.61	3.82	10.14	24.87	41.99	56.02	88.65	21428
Busgov	0	99.26	7.43	13	2.83	13.46	0	0	0	1.1	10	23.81	32.99	62.5	21428
Ba	0	100	16.42	12.63	1.22	5.58	0	2.17	6.85	14.47	23.18	32.2	40.41	55.75	7125
Baa	0	100	11.25	10.62	1.61	7.15	0	0	3.03	8.7	16.4	24.23	32.1	49.91	7125
Baaa	-2.83	100	45.16	24.77	0.14	2.6	0	8.83	28.42	44.61	61.02	77.5	91.23	100	7125
Bb	0	73	2.98	6.9	3.6	19.02	0	0	0	0	2.19	9.5	17.74	33.72	7125
Bbb	0	59.78	3.44	6.55	3.04	14.34	0	0	0	0.54	3.77	11.04	18.19	31.1	7125
Bbbb	0	60.79	8.65	9.09	1.98	7.93	0	0	2.35	6.11	11.68	19.43	26.88	44.38	7125
Bub	0	60.8	0.88	2.8	7.52	99.28	0	0	0	0	0.2	3.02	5.18	12.96	7125

Legend:
Variables (raws): **return**=fund return; **fs**=fund size; **AA**=asset allocation (**e**quity, **b**ond, **c**ash, **o**ther); **E**=sub-asset allocation equity(**asia**, **e**merging **m**arkets, **euro**zone, **uk**, **japan**, **n**orth **a**merica, **inf**ormation, **serv**ices, **man**ufacturing); **B**=sub-asset allocation bond (**us gov**ernment, **us corp**orate, **non-us** government, **cash**, **mortg**age, **aaa, aa, a, bbb, bb, b, u**nder **b**;
Statistics (columns): **min**= minimum value; **max**=maximum value; **mean**=average value; **sd**=standard deviation; **sk**=skewness; **kurt**=kurtosis; **p(n)**=percentile; **md**=median value; **Obs**=number of observations in the sample. The values of percentiles, mean, sd and range (except for fund size) are expressed in percentage.
$*$ = the values are expressed in billions.
Source: own elaboration on Morningstar data.

Table 2: **Summary statistics - for sub-sample periods (January 2005 − June 2007; July 2007 − December 2010)**.

	Panel A: pre-crisis period (January 2005-June 2007)							Panel B: time period from last crisis (July 2007 - December 2010)						
Var/Stat	(1) **min**	(2) **max**	(3) **mean**	(4) **sd**	(5) **sk**	(6) **kurt**	(7) **Obs**	(8) **min**	(9) **max**	(10) **mean**	(11) **sd**	(12) **sk**	(13) **kurt**	(14) **Obs**
return	-18.25	20.72	0.65	2.38	-0.61	6.59	22816	-19.02	15.8	0.2	3.21	-0.9	5.89	11161
fs	0	20300*	823*	1490*	5	34	16839	0	37300*	1380*	2350*	6	47	8837
AAe	-0.79	184.26	51.66	19.02	-0.51	3.57	12687	-2.96	458.23	51.78	20.06	0.33	18.79	10507
AAb	-2.25	170.79	31.65	17.34	0.78	5.88	12687	-32.15	598.85	36.18	20.4	4.24	80.64	10504
AAc	-119.21	493.8	9.79	11.35	12.79	492.09	12686	-543.79	111.18	8.24	13.38	-9.88	378.62	10504
AAo	-488.76	100.1	6.91	18.03	-0.73	96.3	12686	-165.36	94	3.85	10.32	2.54	45.53	10508
Easia	0	100	1.42	2.82	9.54	203.7	12517	0	22.78	1.71	2.08	1.86	8.18	10463
Eem	0	61.42	1.16	2.56	6.89	92.71	12517	0	33.89	2.34	3.29	2.71	14.37	10463
Eeuro	0	100	9.2	16.43	3.51	16.27	12517	0	100	11.44	17.6	3.15	13.61	10463
Ejapan	0	69.09	3.16	5.14	5.17	48.64	12517	0	61.47	3.28	4.89	5.4	49.56	10463
Euk	0	100	8.52	18.78	3.63	15.72	12517	0	100	10.79	21.16	3.16	12.15	10463
Ena	0	100	60.82	33.58	-0.51	1.89	12866	0	100	44.81	31.11	0.09	1.74	5312
Einf	0	72.67	15.61	7.31	0.95	6.19	12514	0	52.68	15.63	5.95	0.96	6.76	10452
Eserv	2.47	100	46.67	8.51	0.43	8.52	12514	0	100	44.26	8.98	0.9	9.05	10452
Eman	0	97.53	37.71	10	0.55	5.72	12514	0	100	40.1	9.55	0.53	6.63	10452
Bnonus	0	100	47.97	34.07	-0.25	1.59	11760	0	100	50.5	33.96	-0.35	1.54	9668
Bcash	0	100	23.7	23.45	1.43	4.77	5754	0	100	26.58	25.23	1.25	3.84	2251
Bmortg	0	99.97	7.42	13.64	1.88	5.54	11760	0	69.61	8.38	14.3	1.65	4.45	9668
Buscorp	0	100	16.09	18.91	1.91	6.77	11760	0	100	18.47	19.13	1.69	6.18	9668
Busgov	0	99.26	6.54	13.21	3.4	17.66	11760	0	84.64	8.52	12.65	2.12	8.23	9668
Ba	0	78.57	17.65	13.1	1.03	4.48	4658	0	100	14.09	11.35	1.66	9.37	2467
Baa	0	100	10.86	9.96	1.84	9.58	4658	0	61.97	11.98	11.72	1.28	4.39	2467
Baaa	0	100	44.85	24.23	0.28	2.82	4658	-2.83	100	45.75	25.76	-0.08	2.28	2467
Bb	0	73	2.21	6.35	4.67	29.83	4658	0	56.75	4.43	7.62	2.43	9.64	2467
Bbb	0	59.78	2.77	6.03	3.61	18.97	4658	0	48.91	4.71	7.27	2.37	9.9	2467
Bbbb	0	60.79	7.8	8.81	2.38	9.95	4658	0	56.6	10.26	9.37	1.42	5.65	2467
Bub	0	60.8	0.46	2.13	11.43	207.59	4658	0	55.12	1.68	3.62	5.22	52.84	2467

Legend:
Variables (raws): **return**=fund return; **fs**=fund size; **AA**=asset allocation (**e**quity, **b**ond, **c**ash, **o**ther); **E**=sub-asset allocation equity(**asia**, **e**merging **m**arkets, **euro**zone, **uk**, **japan**, **n**orth **a**merica, **inf**ormation, **serv**ices, **man**ufacturing); **B**=sub-asset allocation bond (**us gov**ernment, **us corp**orate, **non-us** government, **cash**, **mortg**age, **aaa, aa, a, bbb, bb, b, u**nder **b**;
Statistics (columns): **min**= minimum value; **max**=maximum value; **mean**=average value; **sd**=standard deviation; **sk**=skewness; **kurt**=kurtosis; **Obs**=number of observations in the sample. The values of percentiles, mean, sd and range (except for fund size) are expressed in percentage.
$*$ = the values are expressed in billions.
Source: own elaboration on Morningstar data.

Table 3: **Funds returns and market return: the (*beta factor*).**

Variables	(1) return	(2) return	(3) return	(4) return	(5) return	(6) return	(7) return	(8) return	(9) return	(10) return
Global market	0.92*** (190)	0.92*** (192.51)	0.91*** (188.76)	0.92*** (192.38)	0.92*** (192.38)	0.94*** (173.73)	0.92*** (192.51)	0.94*** (170.51)	0.94*** (173.75)	0.94*** (173.75)
North America		0.13*** (5.05)	0.13*** (5.08)	0.13*** (5.05)	0.13*** (5.05)		0.13*** (5.05)	0.16*** (5.41)	0.16*** (5.4)	0.16*** (5.4)
Post-Crises			-0.38*** (-6.32)					-0.34*** (-6.65)		
Pre-Crisis				0.29*** (-9.4)					0.3*** (4.66)	
Crisis					-0.29*** (-4.96)					-0.3*** (-4.66)
Year Dummies	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Inception date						-0.01 (-0.2)	0.01 (0.2)	0.00 (0.13)	0.01 (0.24)	0.01 (0.24)
Speculative						0.05** (2.18)	0.02 (0.69)	0.02 (0.7)	0.02 (0.7)	0.02 (0.7)
Log Fund size						0.00 (0.21)	0.00 (0.36)	0.00 (0.26)	0.00 (0.42)	0.00 (0.42)
constant	0.07** (2.4)	-0.03 (-0.75)	0.17*** (3.97)	-0.03 (-0.74)	-0.03 (-0.74)	0.03 (0.22)	-0.10 (-0.67)	0.08 (0.54)	-0.11 (-0.73)	-0.11 (-0.73)
Observations	24272	24272	24272	24272	24272	18342	18342	18342	18342	18342
R-squared	0.65	0.65	0.65	0.65	0.65	0.67	0.67	0.67	0.67	0.67

Legend: (In parentheses: robust t statistics) p***¡0.01; ** p¡0.05; * p¡0.1
The table illustrates results from estimates of the following model: $R_{it} = \alpha_i + \beta_i R_{mt} + \sum_d \alpha_d C_{idt} + \varepsilon_{it}$. **return** is the monthly fund's return. **Global market** is the monthly return of the estimated proxy for global market. C_{idt} are the set of control variables (with d, going from 1 to g, is the number of the controls): **North America** is a dummy variable for the geographic region of funds domicile taking 1 if the fund's domicile is in North America, zero otherwise; **Post-Crises**, **Pre-Crisis**, and **Crisis** are dummy variables taking one if the time windows considered are January 2009-June 2010 and November 2001-April 2003; January 2006-June 2007; July 2007-December 2008, respectively; **Year Dummies** are dummy variable for the different years in the sample; **Inception date** is a dummy that is 1 if the fund has been incepted after the first month of the sample (November 2001), zero otherwise; **Speculative** is a dummy variable taking 1 if the fund is a speculative fund, zero otherwise; **Log Fund size** is the logarithm of monthly **fs**. **Constant** is the constant term $\hat{\alpha}_i$ of the estimation model. **Obs** is number of observations in the sample.
Source: own elaboration on Morningstar data.

Table 4: **The effect of diversification and funds' asset allocation choices on idiosyncratic risk**.

	Idiosyncratic risk Panel estimation								Idiosyncratic risk OLS estimation							
Variables	(1a) RSD	(2a) RSD	(3a) RSD	(4a) RSD	(5a) RSD	(6a) RSD	(7a) RSD	(8a) RSD	(1b) RSD	(2b) RSD	(3b) RSD	(4b) RSD	(5b) RSD	(6b) RSD	(7b) RSD	(8b) RSD
Diversification	-0.41***		-0.39***	-0.43**	-0.38**	-0.44**	-0.48**	-0.48***	-0.28***		-0.26***	-0.35**	-0.32**	-0.36**	-0.39**	-0.38***
	(-12.1)		(-11.6)	(-2.21)	(-2.11)	(-2.36)	(-2.52)	(-2.86)	(-10.8)		(-10.1)	(-2.28)	(-2.18)	(-2.40)	(-2.57)	(-2.80)
Av. diversification		2.04***	0.94***	-0.025	0.82**	0.063	0.31	0.96**		2.00***	1.11***	0.55	1.18***	0.61*	0.79**	1.28***
		(25.2)	(9.33)	(-0.056)	(1.99)	(0.15)	(0.71)	(2.52)		(30.9)	(14.1)	(1.57)	(3.57)	(1.81)	(2.33)	(4.11)
Easia				-0.0022	-0.0038	0.0063	-0.0064	0.0026				-0.0057	-0.0069	0.00014	-0.0089	-0.0026
				(-0.26)	(-0.49)	(0.79)	(-0.78)	(0.36)				(-0.86)	(-1.12)	(0.022)	(-1.36)	(-0.45)
Eem				0.014***	0.014***	0.010**	0.012**	0.0076*				0.0024	0.0030	0.000066	0.0013	-0.0017
				(2.66)	(3.03)	(2.09)	(2.45)	(1.73)				(0.60)	(0.79)	(0.017)	(0.34)	(-0.48)
Eeuro				-0.013***	-0.012***	-0.011***	-0.0094***	-0.0041*				-0.016***	-0.015***	-0.014***	-0.013***	-0.0094***
				(-4.64)	(-4.48)	(-3.95)	(-3.34)	(-1.66)				(-7.01)	(-7.00)	(-6.47)	(-5.80)	(-4.58)
Ejapan				-0.037***	-0.029***	-0.033***	-0.033***	-0.022***				-0.026***	-0.020***	-0.023***	-0.023***	-0.015***
				(-7.59)	(-6.45)	(-7.00)	(-6.96)	(-5.23)				(-6.65)	(-5.49)	(-6.06)	(-6.02)	(-4.33)
Euk				0.016***	0.016***	0.014***	0.016***	0.012***				0.014***	0.014***	0.012***	0.014***	0.011***
				(6.13)	(6.61)	(5.50)	(6.05)	(5.40)				(6.66)	(7.12)	(6.10)	(6.59)	(6.04)
Ena				0.0046***	0.0039***	0.0037***	0.0053***	0.0040***				0.0050***	0.0045***	0.0044***	0.0055***	0.0046***
				(3.75)	(3.39)	(3.17)	(4.41)	(3.74)				(5.17)	(4.91)	(4.69)	(5.82)	(5.28)
Bmortg				-0.029***	-0.025***	-0.027***	-0.026***	-0.019***				-0.016***	-0.013***	-0.014***	-0.013***	-0.0085***
				(-10.4)	(-9.71)	(-9.89)	(-9.29)	(-7.81)				(-7.03)	(-6.14)	(-6.44)	(-5.94)	(-4.24)
Bcash				-0.0014***	-0.0011**	-0.0010**	-0.0016***	-0.0010**				-0.0011***	-0.00085**	-0.00079**	-0.0012***	-0.00079**
				(-2.73)	(-2.34)	(-2.06)	(-3.21)	(-2.29)				(-2.64)	(-2.25)	(-2.05)	(-3.09)	(-2.21)
Post-Crises					0.22***			0.11***					0.16***			0.088***
					(13.6)			(6.40)					(12.7)			(6.18)
Pre-Crisis						-0.21***		-0.28***						-0.15***		-0.19***
						(-10.9)		(-13.7)						(-9.32)		(-11.5)
Crisis							-0.16***	-0.21***							-0.12***	-0.15***
							(-8.12)	(-9.78)							(-7.66)	(-8.48)
constant	1.75***	-0.19***	0.99***	1.82***	1.01***	1.80***	1.55***	1.02***	1.48***	-0.34***	0.58***	1.07***	0.46*	1.05***	0.86***	0.47*
	(67.0)	(-2.91)	(11.6)	(4.99)	(2.93)	(5.18)	(4.35)	(3.22)	(72.7)	(-6.49)	(8.63)	(3.69)	(1.67)	(3.77)	(3.05)	(1.80)
Obs	21,424	24,402	21,424	1,239	1,239	1,239	1,239	1,239	21,101	23,995	21,101	1,239	1,239	1,239	1,239	1,239
R-squared	0.06	0.02	0.05	0.22	0.33	0.29	0.26	0.43	0.03	0.05	0.09	0.13	0.29	0.25	0.23	0.37

Legend: (In parentheses: robust t statistics) p***¡0.01; ** p¡0.05; * p¡0.1
The table illustrates results from estimates of the residual values of the following model:
$\sigma_{it}(\varepsilon_{it}) = \alpha_0 + \alpha_1 DIV_{it} + \alpha_2 \overline{DIV_t} + \sum_y \alpha_y V_{iyt} + \sum_d \alpha_d C_{idt} + \upsilon_{it}$, where **RSD** (1a) to (8a) are the standard deviation of the combined residual of panel regression of the model described in (1), and the standard deviation of the residual values of the OLS time series estimation (1b) to (8b) of the model described in (1), respectively. **Diversification** is the monthly diversification index of fund (DIV_{it}). **Av. diversification** is the monthly average diversification of all funds ($\overline{DIV_t}$). V_{iyt} represent the asset allocation variables (with y, going from 1 to q, is the number of the variables): **Ena, Eeuro, Ejapan, Easia, Eem, Euk** are the geographic region asset allocation equity variables for, respectively: North America, European Union countries, Japan, Developed Asian countries, Emerging markets, United Kingdom; **Bcash** and **Bmortg** are the super sectors asset allocation bond variables for, respectively: cash and real estate sector. C_{idt} are the set of control variables (with d, going from 1 to g, is the number of the controls): **Post-Crises, Pre-Crisis** and **Crisis** are dummy variables which indicate a specific arc of time within the time window, respectively: January 2009-June 2010 and November 2001-April 2003; January 2006-June 2007; July 2007-December 2008. **Constant** is the constant term $\hat{\alpha}_i$ of the estimation model. **Obs** is number of observations in the sample.
Source: own elaboration on Morningstar data.

Table 5: **Short term impact of diversification and heterogeneity on funds' returns using market model**.

Variables	(1) return	(2) return	(3) return	(4) return	(5) return	(6) return	(7) return	(8) return	(9) return	(10) return
Global market	0.92*** (179)	0.92*** (179)	0.92*** (175)	0.92*** (179)	0.92*** (179)	0.95*** (163)	0.95*** (163)	0.95*** (160)	0.95*** (163)	0.95*** (163)
Diversification	-0.19* (-1.67)	-0.24** (-2.11)	-0.27** (-2.31)	-0.24** (-2.08)	-0.24** (-2.08)	-0.17 (-1.36)	-0.25** (-2.01)	-0.27** (-2.15)	-0.25** (-1.96)	-0.25** (-1.96)
Heterogeneity (t-6)	-0.40*** (-6.31)	-0.40*** (-6.32)	-0.34*** (-5.36)	-0.40*** (-6.32)	-0.40*** (-6.32)	-0.42*** (-5.86)	-0.43*** (-5.88)	-0.38*** (-5.18)	-0.43*** (-5.87)	-0.43*** (-5.87)
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
North America		0.087*** (3.24)	0.088*** (3.29)	0.087*** (3.22)	0.087*** (3.22)		0.16*** (4.70)	0.16*** (4.73)	0.16*** (4.70)	0.16*** (4.70)
Post-Crises			-0.31*** (-6.42)					-0.28*** (-4.93)		
Pre-Crisis				0.27*** (4.32)					0.27*** (3.94)	
Crisis					-0.27*** (-4.32)					-0.27*** (-3.94)
Inception date						0.0056 (0.18)	0.017 (0.54)	0.015 (0.47)	0.018 (0.57)	0.018 (0.57)
Speculative						0.053** (1.97)	0.020 (0.71)	0.020 (0.74)	0.020 (0.74)	0.020 (0.74)
Log Fund size						0.0075 (0.97)	0.0082 (1.07)	0.0078 (1.01)	0.0086 (1.12)	0.0086 (1.12)
Constant	0.84*** (6.04)	0.82*** (5.86)	0.91*** (6.51)	0.81*** (5.84)	0.81*** (5.84)	0.71*** (3.20)	0.64*** (2.92)	0.74*** (3.33)	0.63*** (2.85)	0.63*** (2.85)
Obs	20757	20757	20757	20757	20757	15818	15818	15818	15818	15818
R-squared	0.66	0.66	0.66	0.66	0.66	0.67	0.68	0.68	0.68	0.68

Legend: (In parentheses: robust t statistics) p***¡0.01; ** p¡0.05; * p¡0.1
The table illustrates results from estimates of the following model: $R_{it} = \alpha_i + \beta_{1i} R_{mt} + \beta_{2i} HET_t + \beta_{3i} DIV_{it} + \sum_d \alpha_d C_{idt} + \varepsilon_{it}$. **return** is the monthly fund's return. **Global market** is the monthly return of the estimated proxy for global market. **Heterogeneity** (t-6) is the diversity level among funds asset allocation six months before the return estimation, **Diversification** is the contemporaneous fund's diversification index. C_{idt} are the set of control variables (with d, going from 1 to g, is the number of the controls): **North America** is a dummy variable for the geographic region of funds domicile taking 1 if the fund's domicile is in North America, zero otherwise; **Post-Crises**, **Pre-Crisis**, and **Crisis** are dummy variables taking one if the time windows considered are January 2009-June 2010 and November 2001-April 2003; January 2006-June 2007; July 2007-December 2008, respectively; **Year Dummies** are dummy variable for the different years in the sample; **Inception date** is a dummy that is 1 if the fund has been incepted after the first month of the sample (November 2001), zero otherwise; **Speculative** is a dummy variable taking 1 if the fund is a speculative fund, zero otherwise; **Log Fund size** is the logarithm of monthly **fs**. **Constant** is the constant term $\hat{\alpha}_i$ of the estimation model. **Obs** is number of observations in the sample.
Source: own elaboration on Morningstar data.

Table 6: **Long term impact of diversification and heterogeneity on funds' returns using market model**.

Variables	(1) return	(2) return	(3) return	(4) return	(5) return	(6) return	(7) return	(8) return	(9) return	(10) return
Global market	0.93***	0.93***	0.93***	0.93***	0.93***	0.97***	0.97***	0.96***	0.97***	0.97***
	(177)	(176)	(174)	(176)	(176)	(161)	(161)	(159)	(161)	(161)
Diversification	-0.18	-0.24**	-0.26**	-0.23**	-0.23**	-0.14	-0.23*	-0.24*	-0.22*	-0.22*
	(-1.47)	(-2.00)	(-2.16)	(-1.97)	(-1.97)	(-1.06)	(-1.75)	(-1.86)	(-1.70)	(-1.70)
Heterogeneity (t-12)	0.49***	0.49***	0.45***	0.49***	0.49***	0.43***	0.43***	0.39***	0.43***	0.43***
	(9.48)	(9.52)	(8.51)	(9.47)	(9.47)	(7.18)	(7.21)	(6.45)	(7.17)	(7.17)
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
North America		0.098***	0.099***	0.097***	0.097***		0.16***	0.16***	0.16***	0.16***
		(3.70)	(3.73)	(3.68)	(3.68)		(4.82)	(4.84)	(4.81)	(4.81)
Post-Crises			-0.25***					-0.22***		
			(-5.20)					(-3.94)		
Pre-Crisis				0.25***					0.26***	
				(4.19)					(3.86)	
Crisis					-0.25***					-0.26***
					(-4.19)					(-3.86)
Inception date						0.011	0.022	0.021	0.023	0.023
						(0.38)	(0.74)	(0.68)	(0.77)	(0.77)
Speculative						0.063**	0.028	0.029	0.029	0.029
						(2.35)	(1.02)	(1.05)	(1.05)	(1.05)
Log Fund size						0.0088	0.0096	0.0092	0.010	0.010
						(1.15)	(1.25)	(1.20)	(1.31)	(1.31)
Constant	-0.63***	-0.66***	-0.43***	-0.66***	-0.66***	-0.76***	-0.82***	-0.62***	-0.83***	-0.83***
	(-5.00)	(-5.28)	(-3.27)	(-5.27)	(-5.27)	(-3.63)	(-3.92)	(-2.87)	(-3.97)	(-3.97)
Obs	20137	20137	20137	20137	20137	15272	15272	15272	15272	15272
R-squared	0.66	0.66	0.66	0.66	0.66	0.67	0.68	0.68	0.68	0.68

Legend: (In parentheses: robust t statistics) p***¡0.01; ** p¡0.05; * p¡0.1
The table illustrates results from estimates of the following model: $R_{it} = \alpha_i + \beta_{1i} R_{mt} + \beta_{2i} HET_t + \beta_{3i} DIV_{it} + \sum_d \alpha_d C_{idt} + \varepsilon_{it}$. **return** is the monthly fund's return. **Global market** is the monthly return of the estimated proxy for global market. **Heterogeneity** (t-12) is the diversity level among funds asset allocation twelve months before the return estimation, **Diversification** is the contemporaneous fund's diversification index. C_{idt} are the set of control variables (with d, going from 1 to g, is the number of the controls): **North America** is a dummy variable for the geographic region of funds domicile taking 1 if the fund's domicile is in North America, zero otherwise; **Post-crises**, **Pre-Crisis**, and **Crisis** are dummy variables taking one if the time windows considered are January 2009-June 2010 and November 2001-April 2003; January 2006-June 2007; July 2007-December 2008, respectively; **Year Dummies** are dummy variable for the different years in the sample; **Inception date** is a dummy that is 1 if the fund has been incepted after the first month of the sample (November 2001), zero otherwise; **Speculative** is a dummy variable taking 1 if the fund is a speculative fund, zero otherwise; **Log Fund size** is the logarithm of monthly **fs**. **Constant** is the constant term $\hat{\alpha}_i$ of the estimation model. **Obs** is number of observations in the sample.
Source: own elaboration on Morningstar data.

Table 7: **Short term impact of diversification and heterogeneity on funds' returns using multi-factor model**.

Variables	(1) return	(2) return	(3) return	(4) return	(5) return	(6) return	(7) return	(8) return	(9) return	(10) return
Global market	0.90***	0.90***	0.89***	0.90***	0.90***	0.92***	0.92***	0.92***	0.93***	0.93***
	(152)	(152)	(148)	(152)	(152)	(139)	(139)	(136)	(139)	(139)
Diversification	-0.20*	-0.25**	-0.28**	-0.25**	-0.25**	-0.18	-0.26**	-0.28**	-0.26**	-0.26**
	(-1.78)	(-2.23)	(-2.42)	(-2.20)	(-2.20)	(-1.46)	(-2.12)	(-2.25)	(-2.09)	(-2.09)
Heterogeneity (t-6)	-0.46***	-0.46***	-0.40***	-0.46***	-0.46***	-0.47***	-0.47***	-0.43***	-0.47***	-0.47***
	(-7.31)	(-7.32)	(-6.35)	(-7.34)	(-7.34)	(-6.57)	(-6.60)	(-5.88)	(-6.60)	(-6.60)
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
North America		0.088***	0.089***	0.088***	0.088***		0.16***	0.16***	0.16***	0.16***
		(3.30)	(3.36)	(3.29)	(3.29)		(4.78)	(4.80)	(4.77)	(4.77)
PostCrises			-0.30***					-0.26***		
			(-6.07)					(-4.69)		
PreCrisis 2007-2009				0.17***					0.16**	
				(2.83)					(2.33)	
Crisis 2007-2009					-0.17***					-0.16**
					(-2.83)					(-2.33)
Inception date						0.0088	0.020	0.018	0.020	0.020
						(0.29)	(0.65)	(0.59)	(0.67)	(0.67)
Speculative						0.054**	0.021	0.022	0.022	0.022
						(2.06)	(0.78)	(0.80)	(0.79)	(0.79)
Log Fund size						0.0073	0.0080	0.0076	0.0083	0.0083
						(0.96)	(1.06)	(1.00)	(1.09)	(1.09)
SMB	0.11***	0.11***	0.11***	0.11***	0.11***	0.11***	0.11***	0.11***	0.11***	0.11***
	(22.6)	(22.6)	(22.6)	(22.3)	(22.3)	(20.6)	(20.6)	(20.6)	(20.3)	(20.3)
HML	-0.00093	-0.00080	0.00057	-0.0017	-0.0017	0.0093*	0.0094*	0.011**	0.0086	0.0086
	(-0.20)	(-0.17)	(0.12)	(-0.36)	(-0.36)	(1.75)	(1.79)	(2.02)	(1.63)	(1.63)
MOM	0.011***	0.011***	0.0096***	0.011***	0.011***	0.012***	0.012***	0.011***	0.013***	0.013***
	(4.68)	(4.70)	(4.21)	(4.94)	(4.94)	(4.74)	(4.75)	(4.39)	(4.95)	(4.95)
Constant	0.85***	0.82***	0.91***	0.82***	0.82***	0.69***	0.63***	0.71***	0.62***	0.62***
	(6.13)	(5.94)	(6.54)	(5.94)	(5.94)	(3.17)	(2.89)	(3.27)	(2.85)	(2.85)
Observations	20757	20757	20757	20757	20757	15818	15818	15818	15818	15818
R-squared	0.66	0.66	0.66	0.66	0.66	0.67	0.68	0.68	0.68	0.68

Legend: (In parentheses: robust t statistics) p***¡0.01; ** p¡0.05; * p¡0.1
The table illustrates results from estimates of the following model: $R_{it} = \alpha_i + \beta_{1i}R_{mt} + \beta_{2i}HET_t + \beta_{3i}DIV_{it} + \beta_{4i}SMB_t + \beta_{5i}HML_t + \beta_{6i}MOM_t + \sum_d \alpha_d C_{idt} + \varepsilon_{it}$. **return** is the monthly fund's return. **Global market** is the monthly return of the estimated proxy for global market. **Heterogeneity** (t-6) is the diversity level among funds asset allocation six months before the return estimation, **Diversification** is the contemporaneous fund's diversification index. C_{idt} are the set of control variables (with d, going from 1 to g, is the number of the controls): **North America** is a dummy variable for the geographic region of funds domicile taking 1 if the fund's domicile is in North America, zero otherwise; **Post-crises**, **Pre-Crisis**, and **Crisis** are dummy variables taking one if the time windows considered are January 2009-June 2010 and November 2001-April 2003; January 2006-June 2007; July 2007-December 2008, respectively; **Year Dummies** are dummy variable for the different years in the sample; **Inception date** is a dummy that is 1 if the fund has been incepted after the first month of the sample (November 2001), zero otherwise; **Speculative** is a dummy variable taking 1 if the fund is a speculative fund, zero otherwise; **Log Fund size** is the logarithm of monthly **fs**. **SMB** (small minus big) is the difference between the returns on diversified portfolios of small and big stocks. **HML** (high minus low) is the difference between the returns on diversified portfolios of high and low B/M stocks. **MOM** is the difference in return between a portfolio of past winners and a portfolio of past losers at time t. **Constant** is the constant term $\hat{\alpha}_i$ of the estimation model. **Obs** is number of observations in the sample.
Source: own elaboration on Morningstar data.

Table 8: **Long term impact of diversification and heterogeneity on funds' returns using multi-factor model**.

Variables	(1) return	(2) return	(3) return	(4) return	(5) return	(6) return	(7) return	(8) return	(9) return	(10) return
Global market	0.91***	0.91***	0.91***	0.92***	0.92***	0.94***	0.94***	0.94***	0.94***	0.94***
	(149)	(149)	(146)	(149)	(149)	(136)	(136)	(134)	(136)	(136)
Diversification	-0.17	-0.24**	-0.26**	-0.23**	-0.23**	-0.14	-0.23*	-0.24*	-0.22*	-0.22*
	(-1.48)	(-2.02)	(-2.21)	(-2.00)	(-2.00)	(-1.09)	(-1.78)	(-1.91)	(-1.74)	(-1.74)
Heterogeneity (t-12)	0.26***	0.26***	0.21***	0.26***	0.26***	0.20***	0.20***	0.15**	0.20***	0.20***
	(4.78)	(4.81)	(3.71)	(4.82)	(4.82)	(3.07)	(3.11)	(2.26)	(3.11)	(3.11)
Year Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
North America		0.097***	0.098***	0.097***	0.097***		0.16***	0.16***	0.16***	0.16***
		(3.75)	(3.79)	(3.73)	(3.73)		(4.81)	(4.84)	(4.81)	(4.81)
PostCrises			-0.28***					-0.25***		
			(-5.81)					(-4.58)		
PreCrisis 2007-2009				0.19***					0.17***	
				(3.06)					(2.58)	
Crisis 2007-2009					-0.19***					-0.17***
					(-3.06)					(-2.58)
Inception date						0.014	0.024	0.023	0.025	0.025
						(0.45)	(0.81)	(0.75)	(0.83)	(0.83)
Speculative						0.0090	0.0098	0.0093	0.010	0.010
						(1.18)	(1.29)	(1.23)	(1.33)	(1.33)
Log Fund size						0.064**	0.030	0.031	0.031	0.031
						(2.43)	(1.11)	(1.13)	(1.12)	(1.12)
SMB	0.099***	0.099***	0.10***	0.098***	0.098***	0.11***	0.11***	0.11***	0.10***	0.10***
	(19.3)	(19.3)	(19.6)	(19.0)	(19.0)	(18.0)	(18.0)	(18.3)	(17.7)	(17.7)
HML	-0.018***	-0.018***	-0.018***	-0.019***	-0.019***	-0.014**	-0.014**	-0.014**	-0.014**	-0.014**
	(-3.48)	(-3.46)	(-3.48)	(-3.65)	(-3.65)	(-2.32)	(-2.30)	(-2.30)	(-2.45)	(-2.45)
MOM	0.0052**	0.0052**	0.0039	0.0059**	0.0059**	0.0048*	0.0049*	0.0037	0.0055**	0.0055**
	(2.15)	(2.15)	(1.59)	(2.41)	(2.41)	(1.74)	(1.75)	(1.33)	(1.98)	(1.98)
Constant	-0.35***	-0.38***	-0.12	-0.39***	-0.39***	-0.48**	-0.54***	-0.30	-0.55***	-0.55***
	(-2.78)	(-3.03)	(-0.90)	(-3.05)	(-3.05)	(-2.28)	(-2.58)	(-1.38)	(-2.63)	(-2.63)
Observations	20137	20137	20137	20137	20137	15272	15272	15272	15272	15272

Legend: (In parentheses: robust t statistics) p***¡0.01; ** p¡0.05; * p¡0.1
The table illustrates results from estimates of the following model: $R_{it} = \alpha_i + \beta_{1i}R_{mt} + \beta_{2i}HET_t + \beta_{3i}DIV_{it} + \beta_{4i}SMB_t + \beta_{5i}HML_t + \beta_{6i}MOM_t + \sum_d \alpha_d C_{idt} + \varepsilon_{it}$. **return** is the monthly fund's return. **Global market** is the monthly return of the estimated proxy for global market. **Heterogeneity** (t-12) is the diversity level among funds asset allocation twelve months before the return estimation, **Diversification** is the contemporaneous fund's diversification index. C_{idt} are the set of control variables (with d, going from 1 to g, is the number of the controls): **North America** is a dummy variable for the geographic region of funds domicile taking 1 if the fund's domicile is in North America, zero otherwise; **Post-crises**, **Pre-Crisis**, and **Crisis** are dummy variables taking one if the time windows considered are January 2009-June 2010 and November 2001-April 2003; January 2006-June 2007; July 2007-December 2008, respectively; **Year Dummies** are dummy variable for the different years in the sample; **Inception date** is a dummy that is 1 if the fund has been incepted after the first month of the sample (November 2001), zero otherwise; **Speculative** is a dummy variable taking 1 if the fund is a speculative fund, zero otherwise; **Log Fund size** is the logarithm of monthly **fs**. **SMB** (small minus big) is the difference between the returns on diversified portfolios of small and big stocks. **HML** (high minus low) is the difference between the returns on diversified portfolios of high and low B/M stocks. **MOM** is the difference in return between a portfolio of past winners and a portfolio of past losers at time t. **Constant** is the constant term $\hat{\alpha}_i$ of the estimation model. **Obs** is number of observations in the sample.
Source: own elaboration on Morningstar data.