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

Rocco Ciciretti[2], Raffaele Corvino[3]

Abstract

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Keywords: Portfolio diversification, Risk, Asset allocation heterogeneity, Market crash.
Jel Numbers: G11, G17.

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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 roots 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 this model 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:

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

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) α_i is the constant term, R_{it} is the return of portfolio i at time t, 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. This portion is defined as 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 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 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 and the average measure of other portfolios diversification, followed by a set of controls (portfolio size, portfolio turnover ratio, year, inception date of portfolio):

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

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 financial system at time t, and V_{iyt} represent the control variables (with y, going from 1 to q, is the number of the controls), 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 to similar threats.[7] In this case the given event affects all agents in the same way. To

[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.

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

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.

$DISP_{it}$ 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, taking also account agent's portfolio size as follows:

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

where HET_t is the weighted average heterogeneity index of the financial system at time t, PS_{it} is the portfolio size of portfolio i 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:

$$R_{it} = \hat{\alpha}_i + \hat{\beta}_{1i} R_{mt} + \hat{\beta}_{2i} HET_t + \hat{\beta}_{3i} DIV_{it} + \eta_{it}, \tag{7}$$

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) 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.

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

[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.

-.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).

The selected balanced funds seem to be really risk-averse because they allocate the largest portion of bond investments to low risk assets (see table 1, column 3 for 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 about 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 for 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: pre-crisis of 2007 (January 2005-June 2007) and over the last financial crisis (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. 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 first period: 5.89% over the last crisis, and 6.59% before the crisis (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 during the last crisis (3.21%, column 4) with respect to the other 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 for variables AAe, AAb, AAc, AAo respectively). It seems obvious to think of the well-known "fly to safety" of investors when the crisis bursts.

5. Estimations results

In this section we implement the estimation model with the dataset described in the previously. In the empirical analysis that follows the agent i described in the estimation model will be proxied by the fund i, while the time t will be the month.[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 (see section 5.3 below). This effect is tested augmenting the classical market model with these two factors. To check the robustness of our model we also consider a multifactor model (Fama and French, 1993 <17>; Carhart, 1997 <8>).

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

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

5.1. Portfolio return, β factor and idiosyncratic risk

The first step of our analysis deals with the investigation of the relationship between funds' returns and market proxy returns, to estimate the beta factor. We estimate the β factor in (1) for both sample period and pre-sample five years period.[11] For the sample period, we perform a random effects panel regression for the equation (1). We also check year effect and region effect. We also define dummies to control for the effect of the 2007-2009 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).

[Insert Table 3, here]

As table 3 shows, the sensitivity of funds returns (Ret) to market returns (Global Market) strongly increased over the past decade. In the pre-sample estimation of (1) the panel β factor was .89. This value has become very close to 1 (.94), the perfect correlation with market returns (table 3, column 1). This value suggests on the increasing consolidation and integration within the market and it is a first evidence of the decreasing diversity across financial agents. In other words, the co-movements of the funds and market returns became more synchronized over time, and the asset allocation pattern of each fund became more and more similar to those of other funds and to average market composition. This trend is more evident for North American funds than European funds, as the coefficient values of dummy region show (column 2). This may be a consequence of the difference in the structure of the financial systems since North America is a markets-oriented and Europe is bank-oriented.

All years between 2001 and 2006 show positive coefficients (table 3, column 3). The highest value appears in 2005 (.46). The statistical significance changes over years with an increasing positive trend until 2005. This result shows that within this decade the value of beta factor substantially increased during the first five years. From the year of the beginning of the last financial crisis in 2007 (with a spike in 2008, -.40) a change in the trend occurs. The burst of the crisis had the consequence of funds' behavior changing from a more aggressive one to a reduction of the systematic component of risk in their portfolios returns.

These findings are supported by the last estimations (columns 4, 5, and 6) with dummy variables to control for the effect of different periods within the time windows of analysis. As stated before, over the years immediately before the past turmoil, the sensitivity of funds' returns to market returns increased following the on-going consolidation of the financial system and an aggressive market strategy of funds, spread by the enthusiasm for the good economics trends and the abundance of liquidity (table 3, column 5). The crisis jeopardized this confidence and the funds began implementing a less aggressive, and less market correlated, strategy. This effect is specially strong over the post-crisis periods (-.38, column 4) rather than over the last crisis period (-.29, column 6).

The results described above stem from a panel regression of model (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:

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

[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.

where model (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 one fund on three) show a beta factor value between .8 and 1.2. These 89 funds can be defined as aggressive with a beta factor of more than one. The largest portion of funds consists of defensive funds with a beta factor less than one.[12]

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.[13]

[Insert Table 4, here]

In the first set of regressions (table 4, columns 1a and 2a) the proxy for idiosyncratic risk is regressed against the funds diversification index DIV_{it}. The coefficients estimated are negative and statistically significant. In the panel estimation (column 1a) the coefficient (-.41) is higher than in OLS (-.29) (column 2a); the latter is more significant. In column 1b and 2b, the estimation takes into account the average diversification $\overline{DIV}_t$ of the financial system. The finding may seem counterintuitive because the coefficient value is positive (1.02 and 1.22, columns 1b and 2b respectively) and sheds light on the positive relation between average diversification of all funds and the idiosyncratic risk of the single fund. Thus, the higher diversification of all funds, the higher appears to be idiosyncratic risk of the single fund.

Table 4 column 1c and 2c include equity asset allocation among six different geographic regions: Asia, Emerging markets, Eurozone, Japan, United Kingdom, North America. All these variables are significant (with the exception of the UK in time series and Eurozone) but they show different signs and statistical significance. In both estimates (columns 1c and 2c), 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 are closely correlated markets and both the last crises affect 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,

[12] Details on this estimation are available from the authors upon request.

[13] In computing the idiosyncratic risk as the standard deviation of residuals of model (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.

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 institutional architecture appears to be more consolidated.

The other outward counterintuitive finding is the significant negative value of mortgage bond coefficients (table 4, columns 1d and 2d). 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. At the opposite, it is more consistent the next result obtained through regressions (1e) and (2e). In these estimates, the cash bonds (with a maturity lower than one year) enter the regression with a negative parameter as can be expected because a short-term investment is more liquid and generally less risky. However, in (1e) and (2e), the variables diversification, average diversification, and UK and Asian equity allocation lose their statistical significance. The estimates of model (3) with control dummy variables confirm that the more speculative funds bear a higher idiosyncratic risk, while the funds incepted after the crisis of 2001 bear a lower idiosyncratic risk. The fund size is not significant.

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.[14] Thus, when diversification increases (until the beginning of recession) the idiosyncratic risk decreases, the heterogeneity degree of financial system moves down and the simultaneous downturn rate grows. This is the effect that may be described with the expression "*the two faces of the same coin*". At the same time, diversification reduces the portfolio-specific risk but increases the likelihood of a simultaneous collapse of financial institutions, given that a systemic event occurs. This hypothesis may be tested through a return estimation model where these two factors enter model of portfolio returns as proposed in equation (7) in the estimation model.

[14] 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 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.

However in figure 1 it also appears that the relation between these two factors and portfolio return is characterized by a lagged effect. For this reason, we construct lagged variables for diversification and heterogeneity (one month, six months and twelve months) and we run panel regressions where the dependent variable is always the monthly fund returns while the independent variables, with the exception of market proxy returns, change. Different combinations of contemporaneous and lagged variables enter into the panel regression to test the significance of the parameters of the return estimation model.

[Insert Table 5, here]

Among all these panel regressions, one only equation shows significant values for all the independent variables with HET_{t-12} and DIV_t. The estimated panel coefficients of lagged heterogeneity and diversification (column 13) evidence the fact that the former has a positive impact on funds return (when the heterogeneity level of financial system increases, the fund return increases) and the latter has a negative impact (when the portfolio diversification increases, the portfolio return decreases).

Given this model estimation (table 5, column 13), it is possible to estimate for each fund the coefficients associated with the parameters described in the model (7), through an OLS time series estimation where the dependent variable is the 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.[15]

We now implement the model (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 estimation model (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 new *market crash* equal to **-2.44%**.

To isolate the effect of diversification or heterogeneity we estimate the predicted average return and SD rate through the estimation model (7) by fixing the market return at the market crash level and, alternatively, diversification and heterogeneity. Thus, we have: a) *market crash* and *maximum heterogeneity*; b) *market crash* and *minimum heterogeneity*; c) *market crash* and *maximum diversification*; d) *market crash* and *minimum diversification*.[16]

[15] 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.

[16] In a) and b) the heterogeneity indicator assumes, respectively, the maximum and the minimum value recorded in the sample (2.88; 1.03) over the entire time window. In c) and d) the diversification index assumes for each fund and each month, respectively, the maximum and the minimum value of the index

This estimation strategy allows us to: i) isolate the effect of diversification/heterogeneity; ii) control the significance of the impact of the variables, and iii) test the statistical significance of the differences between the couples of estimates (a-b; c-d).

Moving from a maximum to a minimum level of heterogeneity the predicted average return drops about .9% over the entire time window with an incidence ratio of about 80% over the estimated return with maximum heterogeneity. The SD rate increases about 25% with an incidence ratio of about 100%. This finding suggests that moving from maximum to minimum heterogeneity of financial system, the ratio of funds that experience a simultaneous downturn doubles.

As argued above, the trend of these two estimates depends only on diversification. This factor seems to especially affect the fund's return when the heterogeneity degree is at minimum value. In this case, when diversification reaches the top values the average return experiences the maximum drop and the SD rate the higher values. The statistical significance of difference between the estimations results in a) and b) is investigated through the t-panel test. The two average returns are, respectively, the estimated average return with maximum and minimum heterogeneity. The results of the test evidence a high statistical significance of this difference over the entire time window. Hence, the difference is substantial and significant.

The same strategy of analysis is implemented when diversification index assumes, respectively, maximum and minimum values and market returns is -2.44%. The trend of SD rate and Predicted Average return is a consequence of the changes in the lagged heterogeneity.

Moving from a maximum to a minimum level of diversification the predicted average return increases over the entire time window of a fixed value (1.34). This condition occurs because we fix the only one parameter that varies not only over time but also over funds. In other words, we fix the only variable that represents the portfolio-specific factors. The incidence ratio is of about 65% over the estimated return with maximum diversification, with a peak in May 2003 (93%). The SD rate decreases of about 5-10% with an incidence ratio of about 20%. The impact on SD rate is much lower than in the previous estimation on maximum and minimum heterogeneity. This finding appears to confirm the fact that, even if diversification is an explaining factor for the homogeneity degree of financial system, it is rather the latter that affects the likelihood of a simultaneous collapse of market agents. The statistical significance of the difference between the estimations results in c) and d) is investigated through the t-panel test. The two average returns considered are, respectively, the estimated average returns with maximum and minimum diversification. The results of the test evidence a high statistical significance and a large difference over the entire time window. Hence, the difference is substantial and significant also in this case.

5.4. The multi-factors model

The return estimation model (7) is now tested augmenting the model factors as well as suggested by the multi-CAPM presented by Fama-French (1993) <17>:

$$R_{it} = \hat{\alpha}_i + \hat{\beta}_{1i} R_{mt} + \hat{\beta}_{2i} HET_t + \hat{\beta}_{3i} DIV_{it} + \hat{\beta}_{4i} SMB + \hat{\beta}_{5i} HML + \eta_{it}, \tag{9}$$

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

(.01; .99). Given these values, the predicted average return and SD rate can be estimated.

returns on diversified portfolios of high and low book to market stocks.[17]

Subsequently, a robustness check is performed considering the augmented model by Carhart (1997) <8>, that extends Fama-French model by incorporating additional fourth factor that considers the momentum anomaly (MOM). The four factor 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 to four elementary strategies:

$$R_{it} = \hat{\alpha}_i + \hat{\beta}_{1i}R_{mt} + \hat{\beta}_{2i}HET_t + \hat{\beta}_{3i}DIV_{it} + \hat{\beta}_{4i}SMB + \hat{\beta}_{5i}HML + \hat{\beta}_{6i}MOM + \eta_{it}, \quad (10)$$

where MOM represents the one-year momentum in stock returns.

The two models (9) and (10) support our results. Model (9) in table 6 confirms the results in column 13 of table 5. Moreover, models (9) shows thst the diversification persists affecting negatively fund's return whereas heterogeneity has now a negative impact with a different lag in time (column 5, table 6). Heterogeneity lag is now only one month whereas in table 5 column 13 was 12 months. In table 6 column 15, heterogeneity shows again positive sign, and diversification is now positive but with a 6 months lag. In all the estimations above, SMB has a positive coefficient suggesting as the small cap funds have higher expected returns, and arguably higher expected risk, than those of large cap. Otherwise in table 6, HML shows a positive sign in estimation 5, and negative in the two other estimations 13 and 15.

Model (10) results are described in table 7. It also supports the findings of both model (7) and (9) for the estimation 13. Here the MOM variable is not significant. In addition, model (10) confirms model (9) for the estimation 5.[18] In table 7 estimation 15 confirms again model (9) even though the added MOM variable is not significant as well as HML.

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.

[17] 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.

[18] Here the positive and significant coefficient of MOM indicates successful timing activity between momentum investing and contrarian investing strategies.

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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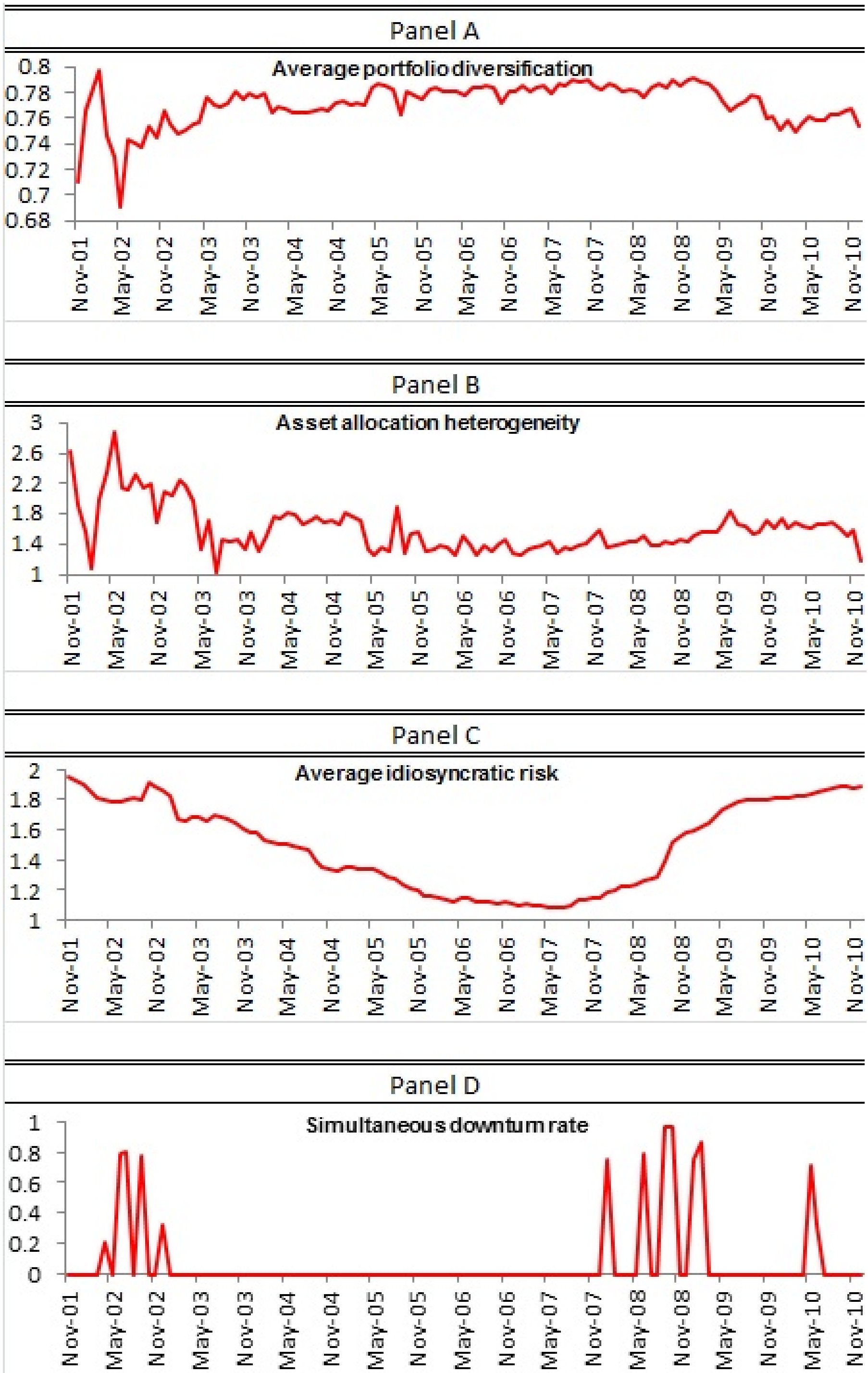
Figure 1: **Overall view**



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

Source: Own elaboration on Morningstar data.

Table 1: **summary statistics of the whole sample**.

Var/Stat	(1) min	(2) max	(3) mean	(4) sd	(5) skewness	(6) kurtosis	(7) p1	(8) p10	(9) p25	(10) p50	(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:
A)on the raws: Variables: fs=fund size; AA=asset allocation (equity, bond,cash, other); E=sub-asset allocation equity(asia,emerging markets,Eurozone,uk,japan,north America,information,services, manufacturing); B=sub-asset allocation bond(us government, us corporate, non-us government, cash, mortgage, AAA, AA, A, BBB, BB, B, under B
B)on the columns: Statistics: min= minimum value; p(n)=number of percentile; max= maximum value; sd=standard deviation; N=number of observation. The statistics are reported for all the years involved in the analysis and all the selected funds. The values of percentiles, mean, sd and range (except for fund size) have to be considered in percentage.
$*$ = the values are expressed in billions
Source: own elaboration on Morningstar data

Table 2: **summary statistics of two different time windows**.

	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) **skewness**	(6) **kurtosis**	(7) **Observations**	(8) **Min**	(9) **Max**	(10) **mean**	(11) **Sd**	(12) **skewness**	(13) **kurtosis**	(14) **Observations**
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:
A)on the raws: Variables: fs=fund size; AA=asset allocation (equity, bond,cash, other); E=sub-asset allocation equity(asia,emerging markets,Eurozone,uk,japan,north America,information,services, manufacturing); B=sub-asset allocation bond(us government, us corporate, non-us government, cash, mortgage, AAA, AA, A, BBB, BB, B, under B
B)on the columns: Statistics: min= minimum value; max= maximum value; sd=standard deviation; N=number of observation. The statistics are reported for all the years involved in the analysis and all the selected funds. The values of mean, sd and range (except for fund size) have to be considered in percentage.
$*$ = the values are expressed in billions
Source: own elaboration on Morningstar data

Table 3: **estimation of sensitivity of fund return to market return (*beta factor*).**

Variables	(1) Ret	(2) Ret	(3) Ret	(4) Ret	(5) Ret	(6) Ret
Global market	0.945***	0.945***	0.919***	0.912***	0.918***	0.918***
	(211..33)	(211.33)	(192.62)	(188.89)	(192.49)	(192.49)
N. America Dummy		0.132***	0.131***	0.131***	0.131***	0.131***
		(5.03)	(5.08)	(5.11)	(5.08)	(5.08)
2001			0.545***	0.741***	0.545***	0.545***
			(6.14)	(8.11)	(6.15)	(6.15)
2002			0.039	0.219***	0.038	0.038
			(0.86)	(4.39)	(0.84)	(0.84)
2003			0.055	-0.009	0.055	0.055
			(1.29)	(-0.2)	(1.3)	(1.3)
2004			0.184***	-0.009	0.184***	0.184***
			(4.4)	(-0.18)	(4.4)	(4.4)
2005			0.469***	0.274***	0.468***	0.468***
			(11.27)	(5.81)	(11.27)	(11.27)
2006			0.054	-0.137***	-0.239***	0.054
			(1.3)	(-2.93)	(-3.32)	(1.3)
2007			-0.256***	-0.45***	-0.403***	-0.11**
			(-6.17)	(-9.54)	(-7.91)	(-2.17)
2008			-0.406***	-0.613***	-0.408***	-0.116
			(-9.47)	(-12.49)	(-9.51)	(-1.59)
2009			0.367***	0.561***	0.367***	0.367***
			(8.84)	(11.9)	(8.85)	(8.85)
Post Crises				-0.382***		
				(-8.64)		
Pre Crisis					0.292***	
					(-4.97)	
Last crisis						-0.292***
						(-4.97)
constant	0.128***	0.028	-0.026	0.171***	-0.025	-0.025
	(10.77)	(1.21)	(-0.72)	(4.04)	(-0.7)	(-0.7)
Observations	24444	24444	24444	24444	24444	24444
R-squared	0.65	0.65	0.66	0.66	0.66	0.66

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: $R_{it} = \hat{\alpha}_i + \hat{\beta}_i R_{mt} + \varepsilon_{it}$ where fund return is the dependent variable in the different regressions. Each column indicates a different estimation regression in order to the different independent variables used in the estimation. Ret is fund return, that is the monthly return of the selected funds between November 2001 and December 2010. Global market is the monthly return of the proxy of the estimated global market. North America is a dummy variable for the geographic region of funds domicile. Post crises, Pre Crisis and Last 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.
Source: own elaboration on Morningstar data

Table 4: **the effect of diversification and fund asset allocation on idiosyncratic risk**.

	Idiosyncratic risk Panel estimation						Idiosyncratic risk OLS estimation					
	(1a)	**(1b)**	**(1c)**	**(1d)**	**(1e)**	**(1f)**	**(2a)**	**(2b)**	**(2c)**	**(2d)**	**(2e)**	**(2f)**
Variables	**Res.St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**	**Res. St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**	**Res.St.Dev.**
Diversification	-0.411***	-0.392***	-1.245***	-0.735***	-0.374	0.059	-0.29***	-0.267***	-1.032***	-0.7***	-0.297	0.372*
	(-10.64)	(-9.96)	(-9.07)	(-6.3)	(-1.15)	(0.19)	(-9.63)	(-8.69)	(-8.25)	(-5.97)	(-0.85)	(1.86)
Av. diversification		1.021***	-0.601	-0.231	0.055	-0.489		1.22***	0.192	0.405	0.665	-0.101
		(8.35)	(-1.58)	(-0.62)	(0.1)	(-0.76)		(11.54)	(0.57)	(1.2)	(1.4)	(-0.21)
Equity Asia			-0.008*	-0.012*	-0.005	-0.009			-0.014***	-0.017***	-0.008	-0.014
			(-1.88)	(-1.85)	(-0.43)	(-0.71)			(-4.07)	(-3.31)	(-0.89)	(-1.52)
Equity EM			0.027***	0.031***	0.02***	0.027***			0.011***	0.015***	0.006	0.014***
			(6.44)	(8.05)	(3.93)	(4.92)			(3.89)	(5.42)	(1.27)	(3.35)
Equity Euro			-0.002	-0.003**	-0.007***	0.000			0.001	0.000	-0.01***	-0.005***
			(-1.59)	(-2.43)	(-3.16)	(-0.02)			(0.46)	(-0.1)	(-5.24)	(-2.95)
Equity Japan			-0.017***	-0.013***	-0.031***	-0.022***			-0.012***	-0.009***	-0.021***	-0.012***
			(-5.63)	(-4.97)	(-6.15)	(-3.96)			(-5.33)	(-4.42)	(-4.34)	(-2.73)
Equity UK			0.003***	0.000	0.012***	0.002			0.000	-0.002*	0.01***	-0.001
			(2.62)	(0.32)	(4.46)	(0.75)			(0.17)	(-1.91)	(4.25)	(-0.27)
Equity NA			0.002***	0.003***	0.002*	0.003***			0.003***	0.003***	0.003***	0.004***
			(4.14)	(5.73)	(1.89)	(3.03)			(7.6)	(9.37)	(3.85)	(4.44)
Bond mortgage				-0.014***	-0.022***	-0.025***				-0.009***	-0.016***	-0.02***
				(-10.85)	(-6.61)	(-6.64)				(-10.7)	(-7.98)	(-9.32)
Bond cash					-0.001	-0.001*					-0.001**	-0.001***
					(-1.42)	(-1.8)					(-2.02)	(-3.04)
Log Fund size						0.018						0.003
						(0.80)						(0.16)
Inception dummy						-0.285**						-0.233**
						(-2.47)						(-2.51)
Speculative dummy						0.503***						0.182**
						(-4.24)						(1.98)
constant	1.754***	0.923***	2.864***	2.303***	1.899***	1.485***	1.478***	0.485***	1.873***	1.530***	1.121***	1.156***
	(41.11)	(8.5)	(9.71)	(8.16)	(3.81)	(2.11)	(36.49)	(5.19)	(7.16)	(5.92)	(2.47)	(2.1)
Observations	21496	21462	7215	6737	1239	936	21139	21139	7045	6567	1239	936
R-squared	0.06	0.06	0.14	0.13	0.21	0.18	0.03	0.03	0.07	0.14	0.19	0.17

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: $R_{it} = \hat{\alpha}_i + \hat{\beta}_i R_{mt} + \varepsilon_{it}$ where the different terms of idiosyncratic risk are the dependent variables in the different regressions: the standard deviation of the combined residual of the same panel regression and the standard deviation of the residual values of the OLS time series estimation of CAPM described in (3). Each column indicates a different regression in order to the different independent variables used in the estimation. Diversification is the monthly diversification index of fund; av. diversification is the monthly average diversification of all funds; Equity NA, Equity Eurozone, Equity Japan, Equity Asia, Equity EM, Equity UK are the geographic region asset allocation equity variables for, respectively: North America, European Union countries, Japan, Developed Asian countries, Emerging markets, United Kingdom; bond cash and mortgage are the super sectors asset allocation bond variables for, respectively: cash and real estate sector; speculative is a dummy variable to take into account speculative grades bond owned by fund; log fund size is the monthly logarithm of size of fund; inception dummy is a dummy variable to control for the fund inception date effect.
Source: own elaboration on Morningstar data

Table 5: **panel estimation of return estimation model with diversification and heterogeneity**.

Variables	(1) Ret	(2) Ret	(3) Ret	(4) Ret	(5) Ret	(6) Ret	(7) Ret	(8) Ret	(9) Ret	(10) Ret	(11) Ret	(12) Ret	(13) Ret	(14) Ret	(15) Ret	(16) Ret
Global market	0.945***	0.943***	0.947***	0.967***	0.946***	0.943***	0.948***	0.966***	0.949***	0.946***	0.947***	0.966***	0.952***	0.95***	0.951***	0.959***
	(198.21)	(198.31)	(194.95)	(191.47)	(198.59)	(198.62)	(195.17)	(189.44)	(196.44)	(196.09)	(193.56)	(189.73)	(190.26)	(190.65)	(189.64)	(188.04)
Heterogeneity	-0.05	-0.02	-0.085*	-0.02												
	(-1.14)	(-0.45)	(-1.75)	(-0.4)												
Heterogeneity(t-1)					-0.06	0.02	-0.07	0.04								
					(-1.5)	(0.35)	(-1.51)	(0.77)								
Heterogeneity (t-6)									0.01	0.05	0.05	0.09*				
									(0.2)	(1.26)	(1.24)	(1.8)				
Heterogeneity (t-12)													0.493***	0.499***	0.522***	0.476***
													(12.87)	(12.97)	(12.89)	(11.09)
Diversification	-0.299***				-0.29***				-0.243**				-0.21*			
	(-2.66)				(-2.58)				(-2.09)				(-1.75)			
Diversification (t-1)		-0.13				-0.12				-0.07				-0.02		
		(-1.12)				(-1.04)				(-0.6)				(-0.19)		
Diversification (t-6)			0.09				0.09				0.12				0.19	
			(0.81)				(0.8)				(1.03)				(1.63)	
Diversification (t-12)				-0.205*				-0.203*				-0.193*				-0.05
				(-1.82)				(-1.81)				(-1.71)				(-0.4)
costant	0.434***	0.254**	0.18	0.31**	0.445***	0.19	0.16	0.20	0.283**	0.08	-0.06	0.13	-0.498***	-0.646***	-0.839***	-0.59***
	(3.69)	(2.21)	(1.5)	(2.46)	(3.88)	(1.64)	(1.35)	(1.62)	(2.46)	(0.71)	(-0.48)	(1.11)	(-4.42)	(-5.75)	(-7.35)	(-5.01)
Observations	21343	21253	20321	19084	21288	21253	20321	19084	20757	20775	20241	19084	20137	20159	19742	19000
R-sqaured	0.65	0.65	0.65	0.66	0.65	0.65	0.65	0.66	0.65	0.65	0.65	0.66	**0.65**	0.65	0.65	0.66

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: $R_{it} = \hat{\alpha}_i + \hat{\beta}_{1i} R_{mt} + \hat{\beta}_{2i} HET_t + \hat{\beta}_{3i} + DIV_{it} \varepsilon_{it}$ where Ret (*Fund return*) is the dependent variable in the different regressions. Each column indicates a different regression in order to the different independent variables used in the estimation. Global market is the monthly return of the proxy of the estimated global market; fund return is the monthly return of the selected funds between November 2001 and December 2010. Heterogeneity is the diversity level among funds asset allocation with different lags, Diversification is the fund diversification index with different lags.

Source: own elaboration on Morningstar data

Table 6: **return estimation model augmented with Fama-French factors**.

Variables	(1) Ret	(2) Ret	(3) Ret	(4) Ret	(5) Ret	(6) Ret	(7) Ret	(8) Ret	(9) Ret	(10) Ret	(11) Ret	(12) Ret	(13) Ret	(14) Ret	(15) Ret	(16) Ret
Global market	0.916***	0.912***	0.918***	0.945***	0.916***	0.911***	0.918***	0.946***	0.922***	0.916***	0.919***	0.946***	0.932***	0.931***	0.932***	0.941***
	(181.65)	(181.16)	(176.02)	(169.48)	(181.69)	(181.26)	(176.13)	(168.93)	(179.07)	(177.88)	(175.31)	(168.92)	(170.21)	(170.16)	(169.05)	(167.41)
Heterogeneity	-0.058	0.017	-0.002	-0.013												
	(-1.33)	(0.39)	(-0.04)	(-0.22)												
Heterogeneity(t-1)					-0.153***	-0.059	-0.133***	-0.050								
					(-3.62)	(-1.36)	(-2.79)	(-0.86)								
Heterogeneity (t-6)									-0.109***	-0.061	-0.054	-0.037				
									(-2.63)	(-1.43)	(-1.23)	(-0.76)				
Heterogeneity (t-12)													0.350***	0.340***	0.383***	0.326***
													(8.87)	(8.50)	(9.18)	(7.31)
Diversification	-0.336**				-0.357***				-0.323**				-0.301**			
	(-2.51)				(-2.67)				(-2.26)				(-1.97)			
Diversification (t-1)		-0.010				-0.044				0.023				0.078		
		(-0.08)				(-0.33)				(0.17)				(0.52)		
Diversification (t-6)			0.311**				0.277**				0.293**			0.000	0.411***	
			(2.36)				(2.10)				(2.20)				(2.95)	
Diversification (t-12)				-0.089				-0.092				-0.096				0.06
				(-0.67)				(-0.69)				(-0.72)				(0.47)
SMB	0.092***	0.095***	0.094***	0.088***	0.092***	0.095***	0.095***	0.088***	0.096***	0.099***	0.096***	0.088***	0.078***	0.079***	0.079***	-0.081***
	(20.40)	(21.08)	(19.81)	(17.72)	(20.29)	(21.13)	(20.01)	(17.75)	(20.17)	(21.11)	(19.94)	(17.68)	(15.76)	(16.05)	(15.90)	(15.92)
HML	0.008**	0.009**	0.004	-0.015***	0.009**	0.010**	0.005	-0.015***	0.001	0.002	0.003	-0.016***	-0.009**	-0.009**	-0.007*	-0.012***
	(2.03)	(2.30)	(0.96)	(-3.39)	(2.20)	(2.35)	(1.05)	(-3.35)	(0.26)	(0.52)	(0.73)	(-3.41)	(-1.99)	(-2.02)	(-1.66)	(-2.62)
costant	0.441***	0.074	-0.146	0.178	0.605***	0.220*	0.085	0.236*	0.499***	0.158	-0.052	0.220*	-0.225*	-0.499***	-0.815***	-0.463***
	(3.31)	(0.57)	(-1.10)	(1.29)	(4.66)	(1.66)	(0.64)	(1.70)	(3.71)	(1.20)	(-0.39)	(1.66)	(-1.67)	(-3.70)	(-6.23)	(-3.44)
Observations	21343	21253	20321	19084	21288	21253	20321	19084	20757	20775	20241	19084	20137	20159	19742	19000
R-sqaured	0.66	0.66	0.66	0.67	0.66	0.66	0.66	0.67	0.66	0.66	0.66	0.67	0.66	0.66	0.66	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: $R_{it} = \hat{\alpha}_i + \hat{\beta}_{1i} R_{mt} + \hat{\beta}_{2i} HET_t + \hat{\beta}_{3i} DIV_{it} + \hat{\beta}_{4i} SMB + \hat{\beta}_{5i} HML + \varepsilon_{it}$ where Ret (*Fund return*) is the dependent variable in the different regressions. Each column indicates a different regression in order to the different independent variables used in the estimation. Global market is the monthly return of the proxy of the estimated global market; fund return is the monthly return of the selected funds between November 2001 and December 2010. Heterogeneity is the diversity level among funds asset allocation with different lags, Diversification is the fund diversification index with different lags, 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 B/M stocks. The two last factors stem from the three factor model of Fama-French and the relative data refer to the Fama-French website dataset for the time window Nov 2001/Dec 2010.

Source: own elaboration on Morningstar data

Table 7: **return estimation model augmented with Fama-French factors and Carhart factor [MOM].**

Variables	(1) Ret	(2) Ret	(3) Ret	(4) Ret	(5) Ret	(6) Ret	(7) Ret	(8) Ret	(9) Ret	(10) Ret	(11) Ret	(12) Ret	(13) Ret	(14) Ret	(15) Ret	(16) Ret
Global market	0.923***	0.919***	0.923***	0.946***	0.922***	0.919***	0.923***	0.946***	0.926***	0.921***	0.923***	0.946***	0.934***	0.933***	0.934***	0.941***
	(168.15)	(168.5)	(164.88)	(161.46)	(167.87)	(168.42)	(164.89)	(161.27)	(166.4)	(166.42)	(164.2)	(161.01)	(161.96)	(162.74)	(161.31)	(160.24)
Heterogeneity	-0.064	0.012	-0.006	-0.013												
	(-1.47)	(0.27)	(-0.11)	(-0.22)												
Heterogeneity(t-1)					-0.15***	-0.052	-0.129***	-0.051								
					(-3.55)	(-1.2)	(-2.7)	(-0.87)								
Heterogeneity (t-6)									-0.109***	-0.059	-0.054	-0.037				
									(-2.63)	(-1.39)	(-1.23)	(-0.76)				
Heterogeneity (t-12)													0.352***	0.343***	0.385***	0.326***
													(8.9)	(8.55)	(9.2)	(7.27)
Diversification	-0.33**				-0.347***				-0.318**				-0.298**			
	(2.53)				(-2.59)				(-2.23)				(-1.96)			
Diversification (t-1)		-0.004				-0.033				0.027				0.081		
		(-0.03)				(-0.25)				(0.2)				(0.54)		
Diversification (t-6)			0.311**				0.279**				0.293**				0.414***	
			(2.36)				(2.12)				(2.2)				(2.97)	
Diversification (t-12)				-0.089				-0.092				-0.096				0.063
				(-0.67)				(-0.68)				(0.72)				(0.46)
SMB	0.092***	0.095***	0.094***	0.088***	0.092***	0.095***	0.095***	0.089***	0.096***	0.099***	0.096***	0.089***	0.078***	0.079***	0.079***	0.081***
	(20.23)	(20.89)	(19.71)	(17.72)	(20.12)	(20.94)	(19.92)	(17.75)	(20.06)	(20.99)	(19.84)	(17.68)	(15.7)	(15.98)	(15.85)	(15.91)
HML	0.011**	0.012***	0.006	-0.016***	0.011***	0.012***	0.006	-0.016***	0.003	0.004	0.005	-0.016***	-0.008*	-0.008*	-0.007	-0.013***
	(2.45)	(2.81)	(1.33)	(-3.32)	(2.59)	(2.85)	(1.38)	(-3.3)	(0.56)	(0.91)	(1.08)	(-3.35)	(-1.77)	(-1.72)	(-1.43)	(-2.61)
MOM	0.006***	0.007***	0.004**	0.000	0.006***	0.007***	0.004*	0.000	0.004*	0.005**	0.004*	0.000	0.002	0.002	0.002	-0.001
	(2.94)	(3.43)	(2.05)	(-0.12)	(2.8)	(3.39)	(1.91)	(-0.19)	(1.7)	(2.16)	(1.95)	(-0.13)	(0.74)	(1.05)	(0.77)	(-0.29)
costant	0.444***	0.077	-0.142	0.178	0.591***	0.200	0.076	0.238*	0.495***	0.152	-0.053	0.22*	-0.231*	-0.507***	-0.82***	-0.462***
	(3.33)	(0.59)	(-1.07)	(1.29)	(4.55)	(1.5)	(0.57)	(1.71)	(3.68)	(1.15)	(-0.4)	(1.66)	(-1.7)	(-3.75)	(-6.26)	(-3.43)
Observations	21343	21253	20321	19084	21288	21253	20321	19084	20757	20775	20241	19084	20137	20159	19742	19000
R-sqaured	0.66	0.66	0.66	0.67	0.66	0.66	0.66	0.67	0.66	0.66	0.66	0.67	0.66	0.66	0.66	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: $R_{it} = \hat{\alpha}_i + \hat{\beta}_{1i}R_{mt} + \hat{\beta}_{2i}HET_t + \hat{\beta}_{3i}DIV_{it} + \hat{\beta}_{4i}SMB + \hat{\beta}_{5i}HML + \hat{\beta}_{6i}MOM + \varepsilon_{it}$ where Ret (*Fund return*) is the dependent variable in the different regressions. Each column indicates a different regression in order to the different independent variables used in the estimation. Global market is the monthly return of the proxy of the estimated global market; fund return is the monthly return of the selected funds between November 2001 and December 2010. Heterogeneity is the diversity level among funds asset allocation with different lags, Diversification is the fund diversification index with different lags, 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 B/M stocks, MOM_t is the difference in return between a portfolio of past winners and a portfolio of past losers at time t. The three last factors stem from the four factors multi-CAPM and the relative data refer to the Fama-French website dataset for the time window Nov 2001/Dec 2010.
Source: own elaboration on Morningstar data